Performance-Based Building Regulatory Systems

Principles and Experiences

A Report of the Inter-jurisdictional Regulatory Collaboration Committee

February 2010

Brian J. Meacham, Editor

NOTICE

This Report was prepared for the Inter-jurisdiction Regulatory Collaboration Committee (IRCC) with support from the Ministry of Land, Infrastructure, Transport and Tourism, Japan (MLIT), the National Research Council, Institute for Research in Construction, Canada (NRC), the New Zealand Department of Building Housing (DBH), and the Scottish Government, Directorate for the Built Environment (DBE). Much of the information presented in this report was provided by Members of the IRCC. Reasonable attempts were made to verify the accuracy of the information provided, referenced and summarized in this report. However, neither the IRCC and its Members, nor any person acting on their behalf:

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PREFACE

In the early 1990s, a handful of countries had implemented functional or performance-based building regulations and several others were in the process of developing them. In 1997, representatives from lead building regulatory development agencies of four countries created a forum for discussing issues associated with the development and implementation of performance-based building regulations: the Inter-jurisdictional Regulatory Collaboration Committee (IRCC). The founders immediately reached out to other countries and the IRCC increased its membership. Recognizing the benefit of capturing and sharing their experiences and challenges, the IRCC published in 1998 a discussion paper entitled *Guidelines for the Introduction of Performance-Based Building Regulations*.

Since the publication of the 1998 *Guidelines*, the IRCC has expanded to include fourteen governmental agency members, and the scope of building regulations has greatly expanded, with the traditional concerns of life safety and public health being joined by requirements on energy efficiency, disabled access, sustainability and more. In addition, the building regulatory environment is becoming increasingly political in some countries, such that it is no longer possible to simply decide issues on a solely technical basis. As a result, the IRCC decided to undertake a complete rewrite of the 1998 *Guidelines*. It was agreed that this new document should *confirm and explain the principles which must underlie a performance based system* (distinguished from the local practices, which should be determined by local conditions and politics), and *record the present position in each member country for the benefit of other countries that might be in process of transforming their system or considering change*.

The result is this document, *Performance-Based Building Regulatory Systems: Principles and Experiences*, which outlines some of the fundamental legal and technical principles of performance-based systems and reflects the experiences of member countries in these areas. This document is structured along four primary concepts: *Why* (why regulation – why performance-based regulation), *What* (technical and legal principles), *How* (experiences of member countries) and *Where To* (emerging issues and future strategies).

- Section 1 discusses the issues of why building regulation, why performance-based systems, and what distinguishes building regulations from building advice. Although building regulations are set for different reasons in different countries, the essential issue of common agreement between IRCC members is that their political systems have decided there are a number of issues of sufficient importance that they require legislative backing. Some of the key reasons are outlined in this section.
- The IRCC is committed to the concept of performance based building regulations. Section 2 aims to explain what this means and the extent to which it can be achieved differently in different countries. This is done by presenting a set of agreed *definitions*, by summarizing *technical principles* which are common to all IRCC members, and where consistency is regarded as essential to a performance based system, and by identifying *legal practices* that reflect how members have set out to achieve the principles within the legal structure of the member country. Additional details regarding *legal practices* in member countries are provided in Annex B.

- Section 3 then provides country-specific experiences with respect to the transition from a prescriptive-based building regulatory system to a functional-, objective- or performance-based system. This includes discussion of the history, process and methods of changing from a prescriptive to a performance based system in a 'case study' format which reflects the experience of IRCC members, discussing how transformation has been effected and how successful it has been. Contact information for each IRCC member is provided in this section as well.
- Section 4 takes a more forward-looking approach, serving as both a list of key issues facing IRCC members and topics to be addressed by the IRCC in its second decade of existence.
- Annex A contains definitions related to performance-based building regulatory systems.
- Annex B contains details regarding *legal practices* in member countries.
- Annex C contains a summary of a survey on application of building regulation to existing buildings conducted by the IRCC.

This *Principles and Experiences* document builds upon – and does not replace – the 1998 Guidelines. It is highly recommended to review the 1998 *Guidelines* in conjunction with this *Principles and Experiences* document, along with associated IRCC papers and reports, to gain a more complete understanding of the current situation and challenges.

Looking ahead, the IRCC recognizes that there is significant benefit in creating a document that looks forward into possible issues and strategies for those countries developing, implementing and maintaining performance-based building regulatory systems. To address this need, the IRCC is in the process of developing a document on *Emerging Issues and Approaches*, which will address performance building regulatory issues that are just now, and anticipated to be, coming on the building regulatory agenda, along with possible approaches to addressing these issues.

Together, the *1998 Guidelines*, this *Principles and Experiences* document, and the forthcoming *Emerging Issues and Approaches* document are offered as a means to help those countries struggling with the issues of performance-based building regulatory systems through the collective experience and perspectives of the IRCC. The IRCC sincerely hopes that all readers of these documents will gain some benefit from this collective experience.

Finally, although steps have been taken to accurately reflect in this document the material provided by IRCC members, invariably, some errors or inadvertent misrepresentations may yet exist. Any such errors or misrepresentations are the responsibility of the Editor and not the members of the IRCC who provided the information.

Brian J. Meacham, Editor

ACKNOWLEDGMENTS

No document such as this – a collection of principles and experiences of several countries – can be possible without the contributions from each country represented. I extend my sincere appreciation to each IRCC member organization and their staff, and other contributors, for generously supporting this effort with their time in developing text, reviewing the document, and providing helpful feedback.

I would especially like to thank the editorial committee who provided detailed reviews, comments and feedback on the content and format of this document, and in addition, facilitated financial support for this effort through their organizations:

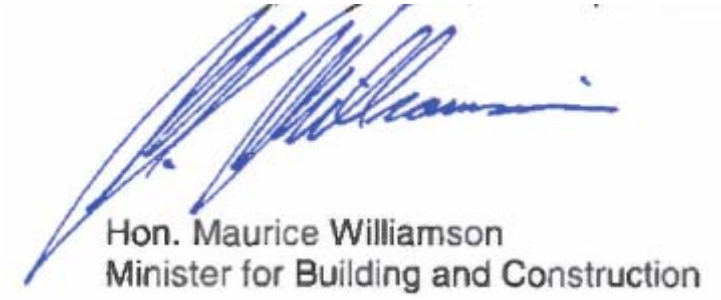
- Mr. Denis Bergeron, National Research Council, Canada
- Mr. William Dodds, Scottish Government, Directorate for the Built Environment, Scotland
- Mr. Mike Stannard, Department of Building and Housing, New Zealand
- Mr. Hiroki Sunohara, Ministry of Land, Infrastructure, Transport and Tourism, Japan

Finally, this document would not have been developed without the foresight and direction provided to this effort by Dr. Paul Stollard, former Chief Executive of the Scottish Building Standards Agency and former member of the IRCC.

Brian J. Meacham

FOREWORD

The New Zealand Government, through the Department of Building and Housing, is pleased to have supported the development of this document and congratulates the IRCC on this important international collaborative effort. A building regulatory system that minimizes red tape whilst facilitating quality buildings, protecting consumers, and allowing for innovation, choice and improved productivity is important for the Government and for New Zealanders. This document provides considerable detail on the regulatory frameworks across a number of countries, and provides helpful benchmarks, comparisons and ideas for considering improvements and for avoiding pitfalls. Working collaboratively and drawing on the experience and ideas of other jurisdictions offers perspectives that cannot be gained when working in isolation. We have gained from our participation in this activity and its outcomes. I'm pleased to endorse this document and the development effort, and hope that others gain value from it as well.



Hon. Maurice Williamson
Minister for Building and Construction

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INTRODUCTION

In many parts of the world, building regulations developed from a desire to mitigate the potential for unacceptable losses of life, property and economic stability due to fire and natural hazard events. Over time, other aspects of occupant health and safety have become embodied in building regulations, addressing such issues as protection from falls, glazing, and unacceptable accumulation of moisture, and the provision of sanitary facilities. Within the past quarter century, additional societal concerns have begun to be addressed, including accessibility, indoor air quality, energy and resource efficiency, and sustainability.

The combination of an increasing number of regulated areas, the complexities and limitations associated with trying to capture all possible issues in a single regulation for all building types and uses, and a desire to better balance regulatory and market solutions, amongst other issues, has led many countries to consider regulatory structures which focus more on the desired function of the delivered building than on a detailed set of prescriptions for how to construct a building. The result has been a transition by several countries to functional, objective-based, or performance-based building regulations.

The transition to functional, objective-based, or performance-based building regulatory systems began in the late 1970s, with the first generation of the 'new' regulations being promulgated in the 1980s and 1990s. By the mid-1990s, there was enough activity in this area that a small group of countries, which had implemented or were developing function-based, objective-based, or performance-based, came together to create a forum for international discussion and dissemination of information regarding these new approaches.

ABOUT THE IRCC

Formed in 1997 following discussions between four countries who were working on performance-based building regulatory systems, the Inter-jurisdictional Regulatory Collaboration Committee (IRCC) has grown to a committee that includes fourteen of the lead building regulatory agencies and organizations of thirteen countries:

- The Australian Building Codes Board (ABCB), Australia;
- The Austrian Institute of Construction Engineering (OIB), Austria;
- The Building and Construction Authority (BCA), Singapore;
- The China Academy of Building Research (CABR), China;
- The Department of Building and Housing (DBH), New Zealand;
- The Department for Communities and Local Government (DCLG), England and Wales;
- The Institute for Research in Construction, National Research Council (NRC), Canada;
- The International Code Council (ICC), USA;
- The Ministry of Housing (MOH), Spain;
- The Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan;
- The National Board of Housing, Building and Planning, (Boverket), Sweden;
- The National Institute for Land and Infrastructure Management (NILIM), Japan;
- The National Office of Building Technology and Administration (NOBTA), Norway; and
- The Scottish Government Directorate for the Built Environment (DBE), Scotland.

Created as a means to facilitate international discussion on issues related to the development and promulgation of functional, objective-based and performance-based building regulation, a principal aim of the IRCC is to foster a common understanding of the international building regulatory environment, while also promoting the global exchange of information, and a more open environment of inter-jurisdictional commerce in building design and construction. The IRCC meets twice a year to discuss these and other emerging issues, and to share experiences between members.

A fundamental purpose of the IRCC is to produce documents on the development, implementation and support of construction-related, performance-based regulatory systems, with a focus on identifying public policies, regulatory infrastructure, education and technology issues for implementing and managing these systems. As a first step, the IRCC published a collection of issues, challenges, and member's experiences in the May 1998 document, *Introduction to Performance-Based Building Regulatory Systems* (downloadable version at www.IRCCbuildingregulations.org). The document contains five primary chapters – Technology, Education, Public Policy, Support Framework, and Process Management – most of which include discussion of critical issues followed by member-country experiences. This document was used by some countries in the formulation of their own performance-based building regulations, including Scotland, Spain and the USA. The IRCC members also published several position papers – alone, in concert with the International Council for Research and Innovation in Building and Construction (CIB), and in collaboration with others – on related issues (several of these papers are available on the IRCC website).

In addition to their bi-annual meetings, and occasional publications, the IRCC recognized that it could facilitate discussions and information exchange amongst a broader group and on a more diverse set of building regulatory topics. In the early 2000s, for example, it was observed that the now global economy would result in continuing changes to domestic and international building regulatory policy. Questions on the table at the time included: how does a country respond to World Trade Organization (WTO) language that points to prescriptive language in standards – heretofore a national issue – as a barrier to trade, and that performance measure must be used? Should the standardization community drive the levels of acceptable risk and building performance over national requirements? What units of performance measure are regionally, nationally, or internationally accepted? What mechanisms exist to demonstrate that national performance expectations and requirements are being met? What is the role for building regulation with respect to accessibility, changing demographics, climate change and sustainability?

These are not simple questions, as there are myriad impacts on building regulation, ranging from the form of government and legal system, to the role of special interest groups, to the question of what should be government regulated versus market driven, to limits of technology. To explore these issues in more detail, the IRCC organized and held the *Global Policy Summit on the Role of Performance-Based Building Regulation in Addressing Societal Expectations, International Policy and Local Needs* in Washington, DC, in November 2003. The Summit attracted nearly 100 leading thinkers, policy-makers, and practitioners from eleven countries to address issues and offer their insights on the role and challenges of performance-based regulatory systems. Although the Summit did not profess to answer all

the questions, it aimed to raise issues and begin the development of a roadmap for addressing the issues in a coordinated, global manner.

Following the success of the global policy summit, the IRCC has embarked on a series of summits and workshops on topics of current interest in the building regulatory community. These include a summit on sustainability (Gold Coast, Australia, September 2005) and workshops on the use of risk concepts in performance regulation (San Francisco, CA, October 2006), on fire performance and criteria (Vienna, Austria, October 2007), carbon footprint and sustainability issues (Wellington, NZ, April 2008), and challenges with historic and heritage buildings (Madrid, Spain, November 2008). Reports from each of these events, as well as discussion papers on a variety of topics, including regulatory impact analysis and international trade issues, are freely available on the IRCC website (www.IRCCbuildingregulations.org).

ABOUT THIS DOCUMENT

Through its efforts over the past ten years, the IRCC has played a significant role in helping countries better understand issues, challenges and benefits of performance-based building regulations. In Spain, the IRCC and its guidelines for the introduction of performance-based building regulations were mentioned in the Royal Decree which empowered the performance-based building code in that country. In addition, several countries have participated as guests – some becoming members, others looking to join – to learn as they embark on changes to their building regulations, including in some cases their transformation to performance.

Looking forward, with the intent to continue its important role in facilitating international discussion on issues related to the development and promulgation of performance-based building regulatory systems, to share information and experience on emerging societal pressures and needs, and to collaboratively work to provide robust building regulatory instruments for use by all who can benefit, the IRCC decided to publish an update to the 1998 Guidelines. The rationale was that although the issues raised by the 1998 document are as relevant now as they were then, each of the countries who then participated (Australia, Canada, Japan, New Zealand, England & Wales, and the USA) have refined and advanced their own systems, and in addition, the IRCC has welcomed members from Austria, China, Norway, Scotland, Singapore, Spain, and Sweden, each of which has developed and/or implemented a system of building regulation based on functional, objective-based or performance-based principles.

However, since the scope of building regulations has expanded in many countries, with the traditional concerns on life safety and public health being joined by requirements on energy efficiency, disabled access, sustainability and more, and with the recognition that in some countries building regulations are becoming increasingly political, such that it is no longer possible to simply decide issues on a solely technical basis, it was agreed that it was not feasible to produce only an 'update' of the 1998 Guidelines, which would simply be a minor updating of the first, but that a complete rewrite was necessary. It was agreed that the new document should *confirm and explain the principles which must underlie a performance based system* (distinguished from the local practices, which should be determined by local

conditions and politics), and *record the present position in each member country for the benefit of other countries that might be in process of transforming their system or considering change*. It was also agreed that in addition to capturing a 'snapshot in time' with respect to performance-based building regulatory systems, that there is benefit to creating a document that looks forward into possible issues and strategies for those developing, implementing and maintaining performance-based building regulatory systems.

As a result, it was decided to produce the rewrite in two volumes – this document, *Principles and Experiences*, which outlines some of the fundamental legal and technical principles of performance-based systems and reflects the experiences of member countries and the Netherlands in these areas, and *Emerging Issues and Approaches*, which will address issues that are just now, and anticipated to be, coming on the building regulatory agenda, and possible approaches to addressing these issues which are envisioned by the IRCC. This document is structured along four primary concepts: *Why* (why regulation – why performance-based regulation), *What* (technical and legal principles), *How* (experiences of member countries) and *Where To* (emerging issues and future strategies).

- Section 1 discusses the issues of why building regulation, why performance-based systems, and what distinguishes building regulations from building advice. Although building regulations are set for different reasons in different countries, the essential issue of common agreement between IRCC members is that their political systems have decided there are a number of issues of sufficient importance that they require legislative backing. Some of the key reasons are outlined in this section.
- The IRCC is committed to the concept of performance based building regulations. Section 2 aims to explain what this means and the extent to which it can be achieved differently in different countries. This is done by presenting a set of agreed *definitions*, by summarizing *technical principles* which are common to all IRCC members, and where consistency is regarded as essential to a performance based system, and by identifying *legal practices* that reflect how members have set out to achieve the principles within the legal structure of the member country. Additional details regarding *legal practices* in member countries are provided in Annex B.
- Section 3 then provides country-specific experiences with respect to the transition from a prescriptive-based building regulatory system to a functional-, objective- or performance-based system. This includes discussion of the history, process and methods of changing from a prescriptive to a performance based system in a 'case study' format which reflects the experience of IRCC members, discussing how transformation has been effected and how successful it has been. Contact information for each IRCC member is provided in this section as well.
- Section 4 takes a more forward-looking approach, serving as both a list of key issues facing IRCC members and topics to be addressed by the IRCC in its second decade of existence.

As noted above, this *Principles and Experiences* document builds upon – and does not replace – the 1998 Guidelines. It is highly recommended to review the 1998 Guidelines in conjunction with this *Principles and Experiences* document and related IRCC papers and reports to gain a more complete understanding of the current situation and challenges.

CONTACTING THE IRCC

The IRCC is a self-supporting committee of people and organizations dedicated to the understanding, advancement and rational implementation of performance-based building regulatory systems. As a means to coordinate the meetings and activities of the IRCC, a Chair and Secretariat are elected from the membership, each with a term limit of three years (election for more than a single term is acceptable).

The Members of the IRCC are listed above, in Section 3, and on the IRCC website (links to member organizations are included in Section 3 and on the IRCC website). Questions about the IRCC can either be directed to any member listed of the IRCC or to the current Chair or Secretariat, as listed below. The current Chair and Secretariat are as follows. Please refer to the IRCC website for the most current information (www.IRCCbuildingregulations.org).

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1.0 BUILDING REGULATION

For much of the world, buildings are an essential component of societies and economies, providing safe and healthy environments for people to live and work. They provide shelter from the elements. They provide places for people to congregate for commerce, entertainment, and worship. They house critical infrastructure necessary to keep government and business in operation. They represent a significant percentage of gross national product in terms of the resources needed for design, materials, construction, use, operation and maintenance.

For these reasons and more, the political and legal systems in many countries require that most buildings must meet some minimum level of performance. In many countries, the minimum performance has historically reflected health, safety and welfare (wellbeing) of the occupants, with some countries including protection of neighboring properties and/or protection of the property (building) itself under various hazard conditions. Increasingly, performance requirements are being sought for issues such as accessibility, affordability, resource efficiency and sustainability as well. To assure that the minimum requirements – whatever they are – are achieved at the time of building design and construction, and that suitable enforcement measures are in place to ensure compliance throughout the life of the building, minimum performance has been mandated by legislation in the form of building regulation (building codes, building standards).

Building regulations are legal instruments intended to ensure that buildings, when constructed and used in accordance with the regulations, provide socially acceptable performance with respect to the building and the welfare of its occupants and the community in which the building is located. This is often accomplished through regulatory controls on the design, construction and operation of buildings, covering such diverse areas as structural stability, fire safety, heating, lighting, ventilation, plumbing, and sanitary facilities, and may include accessibility, affordability, indoor air quality, energy, and sustainability.

Building regulations are often supported by an extensive collection of material, product, testing, design and installation standards, as well as codes of practice and design guidance from professional and industry organizations.

The combination of building regulations, enforcement mechanisms, standards, guidance documents and related support measures form the building regulatory system.

1.1 WHY BUILDING REGULATION?

Understanding what is encompassed in a building regulatory system is important, but one might also question: why building regulation – why not let the market address the needs? The market does play an important role, through building owners, architects, engineers, insurers, contractors and material suppliers, but there are some fundamental issues that can justify government intervention through regulation.

ESTABLISHES MINIMUM STANDARDS

Left solely to the market, there could be significant variation in the minimum level of building performance, within and between communities, over a wide range of building function. As such, governments sometimes intervene in the market for the social purpose of ensuring certain minimum standards of health, safety and welfare.

This need for regulated minimums has been seen time and again in such areas as prevention of fire spread to neighboring property (e.g., the 1666 fire which destroyed much of London, city-leveling conflagrations in the USA in the 1800s, fires following earthquakes in San Francisco (1906), Tokyo (1923), and Kobe (1995)), safety in case of fire (e.g., dance hall / discotheque fires in Boston (1945), Madrid (1983), Gothenburg, Sweden (1998), China (2000), and Rhode Island (2003)), and natural hazards (e.g., earthquakes in Japan, New Zealand and the USA). Over time, governments have also seen the need to ensure minimum standards for sanitary facilities, adequate potable water, and related health issues.

More recently, civil rights legislation, such as access for all, have created new areas where building regulatory measures can help benchmark minimums. This is often necessary since it is most unlikely that certain building qualities, such as access for people with disabilities, would be delivered widely and consistently in the absence of government intervention.[1] As new pressures and challenges emerge, such as a rapidly aging population, increased urban densification, and resource sustainability, building regulation can be an effective tool for reflecting minimum societal expectations for the built environment.

REDUCES UNCERTAINTY AND FACILITATES TRADE

Building regulations outline a common set of requirements for buildings to be constructed within, and sometimes between, jurisdictions. For most buildings, this allows the market a high degree of certainty in terms of such factors as acceptable methods and materials of design and construction, minimum building features and functions, and approval of designs. For industry, this means that operational efficiencies can be gained in the manufacturing, design, construction and approval processes. Building regulation can also facilitate trade between jurisdictions, since a clear path to approval of products and systems is known.

ADDRESSES CHALLENGES OF COMPLEX INFORMATION AND KNOWLEDGE GAPS[1]

Building regulations can also provide consumers with confidence that all buildings of a similar type constructed within a jurisdiction are benchmarked against the same standards. This can serve to reduce some of the uncertainty in real estate transactions for new construction. This is important, as it is difficult for some buyers and users of buildings to ascertain and/or understand some characteristics of buildings.

Purchasers, who are infrequent buyers, are not easily able to ensure that the building in fact meets the qualities they think they are paying for and are often not even aware of what could go wrong. Also, users (such as tenants and workers) are often not in a position to fully assess building performance, as once a building is completed some aspects are concealed within the building fabric and impossible to inspect thoroughly. Aspects of buildings that are subject to information gaps with potentially significant adverse impacts include:

- Structural soundness
- Effectiveness of the protection against fire;
- Use and impacts of materials, such as asbestos, that could cause painful and life-shortening diseases;
- Ability to withstand the impacts of natural hazards, such as earthquakes (ground motion), tornados (high wind), hurricanes or cyclones (high winds, flooding), heavy rain, snow or ice (load on structure; flooding); and
- Indoor environment.

Other (non life-threatening) matters include the quality of service the building provides, for example, sound and weather-proofing. By providing minimum standards which address these issues, building regulation provides a means of increasing consumer confidence.

[1] Extracted from discussion in *Productivity Commission report on Reform of Building Regulation*, Australia, 2004

ADDRESSES SPILLOVER COSTS (NEGATIVE EXTERNALITIES)[1]

The market does not always work as desired in meeting societal needs. One potential aspect that a market-based approach may not adequately address is spillover costs. In brief, spillover costs refer to the negative impacts experienced by people other than those directly engaged in a particular activity, for example, noise from one household impacting on neighbors. In the absence of government intervention (or other means of action), the person responsible does not bear the full costs of the adverse effects and so has no incentive to mitigate or compensate for those effects.

Other aspects of buildings that may have adverse effects on others include:

- Deficiencies in building safety;
- The dangers and costs imposed on owners and occupants of adjacent buildings when little has been done to contain fire to the building in which it occurs;
- Adverse environmental impacts from emission of toxic substances into public drains; and
- Adverse environmental impacts from energy use (where the price does not reflect the effects of greenhouse gas emissions or other pollution).

1.2 WHY PERFORMANCE REGULATION?

Historically, building regulation has been largely a collection of prescriptive (descriptive) specifications that dictate how a building must be built, including what materials can be used, how they may be used, and when they can be accepted.

Empirically developed over many decades, and often the result of a building failure or loss of some type, most of the prescriptive requirements speak to what is needed and when (e.g., doors of some minimum width, equipped with door-closers, and which open in the path of exit travel, are required when the path of travel exceeds 35 m), rather than why and for what purpose (e.g., to provide occupants with the ability to safely and rapidly evacuate in the event of a fire and limit the spread of smoke in a building).

Although prescriptive regulations are generally helpful to enforcement officials when reviewing plans and checking construction for compliance with the specifications (it is easy to measure a door width or check the swing of the door), it is often difficult to ascertain the actual level of performance delivered by the specifications (e.g., how well do automatic

door-closers work in preventing the spread of smoke if the doors are blocked open?), or what alternative methods to the specification might exist (e.g., electro-magnetic door holders that keep the door open for normal pedestrian flow yet release on alarm and close the door automatically in the event of a fire). In addition, since the specifications are meant to broadly address classes of buildings, such as "businesses," they lack the ability to account for real differences in how appropriate performance might be provided for each unique building or structure (the building performance requirements for a sign painting business might differ significantly from those for a law firm).

In contrast, performance-based building regulation focuses on the outcomes that are envisioned for a building and less on specific materials, assemblies, construction and installations. Performance-based regulation does this by including explicit statement of policy goals and objectives that reflect societal expectations and desires, along with functional statements, operative requirements, and performance criteria which are used for demonstrating that functional (societal, policy) goals and objectives have been met.[2, 3, 4]

PROVIDES A MORE TRANSPARENT SYSTEM

As introduced above, the prescriptive building regulatory requirements in several countries have been empirically developed over many decades, taking account of the collective experience of the industry, government and stakeholders in the regulatory development process. As a result, it has often been the case the regulations have been updated and revised in small and distinct parts as new data or technology has become available, with limited assessment of how the individual parts work together as a whole. In a performance-based system, where the focus is on clear statements of functional and performance expectations, simple and concise language can be used so that all stakeholders have a clear understanding of the regulatory intent and means for demonstrating compliance. This allows for better scrutiny, discussion and debate from a broader cross-section of the community.

FASTER AND MORE TARGETED RESPONSE TO MARKET NEEDS

With the focus on outcomes rather than specifications, performance-based regulations are better equipped to take advantage of market capabilities to quickly and appropriately respond to changes, pressures and threats impacting the built environment without compromising core objectives of health, safety and welfare. This includes adapting to such factors as changing demographics (aging population, percentage of persons with disabilities – permanent or temporary), sustainability (energy performance, materials usage, carbon

[2] IRCC (1998). *Guidelines for the Introduction of Performance-Based Building Regulations*, published by the Australian Building Codes Board, Canberra, ACT, Australia (www.IRCCbuildingregulations.org).
[3] Meacham, B.J., Tubbs, B., Bergeron, D., and Szigeti, F. (2002). "Performance System Model – A Framework for Describing the Totality of Building Performance," *Proceedings of the 4th International Conference on Performance-Based Codes and Fire Safety Design*, SFPE, Bethesda, MD, pp.63-77.
[4] NKB (1978). Nordic Committee on Building Regulations (NKB), *Structure for Building Regulations*, Report No. 34, Stockholm.

footprint), resilience to extreme events (driven by climate change, acts of malice or other), and rapid changes in technology and practice which could result in defective design or construction (inadequate ventilation, plumbing cross-connections, leakages, etc).

CONSISTENT WITH INTERNATIONAL TRADE OBJECTIVES AND AGREEMENTS[5]

The influence of building regulations is not confined within national borders. Governments and industry are increasingly seeing the relationship between their internal regulatory framework and the impact that such regulations have upon their industries' ability to operate within the global economy. In part, this is a response to the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO) – such international trade agreements require all trade barriers to be dropped, thus demanding transparency of requirements. With a system of purely prescriptive codes, it can be difficult for a recipient country to understand what level of performance is actually provided in the products from an exporting country. This is a function of many factors, including different test methods, standards and criteria, and if the fundamental performance expectation is not stated, it is difficult to compare one method to another.

During the Tokyo Round of General Agreement on Tariffs and Trade (GATT) negotiations, concern over the growth of technical barriers to trade led to the development of a voluntary Code on Technical Barriers to Trade (TBT) agreed in 1995. This voluntary code was strengthened and made binding on all World Trade Organization (WTO) members during the Uruguay Round of GATT negotiations. WTO TBT requires that, for technical regulations affecting trade, *technical regulatory requirements must be specified where possible in terms of performance rather than design or descriptive characteristics*.

Selecting, designing and assessing regulatory responses[6]

Departments and agencies are responsible for assessing the effectiveness and appropriateness of regulatory and non-regulatory instruments for achieving policy objectives. Departments and agencies are to:

- Specify, particularly for technical regulations, regulatory requirements in terms of their performance rather than their design or descriptive characteristics
- Make use of all or parts of relevant national or international standards, guidelines, and recommendations as a basis for technical regulations and for conformity assessment procedures when they fulfill intended policy objectives.

In contrast, a performance-based approach, with clearly defined criteria, can reduce ambiguity concerning the performance expectations. As a result, member economies that are signatories to the WTO GATT have committed themselves to the use of performance requirements in evaluating a products' fitness for purpose and in accepting new and/or innovative products in their market.

A performance-based regulatory system is therefore conducive to the global trade environment:

- Performance-based codes will provide international credibility;

[5] Extracted from Deroukakis et al., *Performance-Based Codes: Impact on International Trade*, IRCC Occasional Paper, IRCC, October 2000 (www.IRCCbuildingregulations.org).
[6] *Cabinet Directive on Streamlining Regulation*, Government of Canada, 2007, pp5-6 (http://www.regulation.gc.ca/directive/directive-eng.pdf, accessed and downloaded on January 10, 2009)

- Performance-based codes will provide a common basis upon which products and solutions can be compared and assessed, which can be used to create a common market
- Performance-based codes can be used as a marketing device to expand trade opportunities;
- Support of innovative products/new technologies will provide new export opportunities;
- Performance-based codes can simplify product and system conformity assessment procedures.

The performance-based approach is also consistent with the European Union's New Approach[7] agreed by the European Commission in 1985. This approach was adopted in order to change the way European directives for harmonization of the internal market were drafted so far. The idea was to change from the old fashion prescriptive directives to the new performance-focused ones. Since then more, than 20 new approach directives have been approved. They are based in the performance-based concept by establishing the so-called 'essential requirements' that are the core of these European directives. So, national legislations which transpose them, adopt the European essential requirements written in a performance way. The way of compliance of the essential requirements is left to the European harmonized standards, which come from Commission mandates and are drafted and adopted by industry and stakeholders in the European Standards Committee. Once a European harmonized standard is available for a product under a particular directive it allows the manufacturer to use the CE marking as a passport that removes any national barrier and then achieving the European internal market.

Among the said directives, the one which has affected the European building regulatory environment has been the Construction Products Directive (CPD)[8] adopted in 1989. It required the amendment or replacement of existing EU member states' references to national technical standards in their national construction regulations adopting the Europe-wide harmonized technical specifications for construction products. Because of that, all 27 European Union Member States have redrafted their building regulations in order to adopt the European approach. Currently there are several hundreds of European harmonized standards applicable to the building industry.

In brief, the CPD was introduced to create an effective single market for construction products across the European Union, reducing barriers to trade which could result from highly-prescriptive requirements and methods of verification. It aimed to accomplish this through a system which focused on six *essential requirements,* which are established for buildings and civil engineering works and not for construction products, and that conformity with the principles of the directive are to be assessed by application of harmonized technical specifications.[9] The essential requirements are set as performance requirements for buildings and civil engineering works and are as follows:

[7] See European Commission "Guide to the implementation of directives based on the New Approach and the Global Approach".2000. www.newapproach.org/

[8] Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products.
http://ec.europa.eu/enterprise/construction/internal/cpd/cpd.htm

[9] Salazar-Mitchell, J.P. (2004). "The Role of European Technical Specifications and Their Impact on National Regulations for Building and Construction: The Road Towards Harmonization," in

1. Mechanical resistance and stability;
2. Safety in case of fire;
3. Health, hygiene and environment;
4. Safety in use;
5. Protection against noise; and
6. Energy economy and heat retention.

FACILITATES INNOVATION WHILE ASSURING MINIMUM PERFORMANCE

For decades countries have been challenged when innovative products or systems wanted to be introduced in the construction market, normally a very traditional and reluctant sector closed to innovations. National bodies or Building research institutes, gathered in organizations such as the European Approval Union, UEATc[10], also known as European Union of Agrèment, set in 1960, and more recently the World Federation of Technical Approval Organizations, WFTAO[11], have worked in the assessment of innovative products or systems issuing certificates that allowed their manufacturers to remove the market barriers. Those bodies have profited of and they still are using the performance concepts for the evaluation of those innovations as the best tool to assess something new that is not envisaged by the standards.

A performance-based approach creates more opportunities for innovative buildings and solutions. Because performance requirements focus on what must be achieved, but do not tell the designer what materials to use or how to assemble them, the designer has considerable flexibility in selecting materials, products and systems that can achieve the required performance. However, the designer must demonstrate, to the satisfaction of the approval authority, that the required performance has been met. In many cases, this imposes an additional level of rigor in the analysis and design beyond that typically seen under prescriptive regulation, since the building must be shown to perform acceptably under a wide range of conditions.

ADDRESSES CHALLENGES WITH EXISTING BUILDINGS[12]

In most countries, new construction accounts for only a very small fraction of the total building inventory. For some building regulatory issues of key importance, however, there is a need to have a more rapid impact on the performance and quality of the entire building stock – not just new buildings – which results in the application of building regulations to existing buildings. In addition to the challenges associated with prescriptive regulations as outlined above, the regulation of existing buildings is further complicated by such factors as

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Meacham, B. J., Editor, *Global Policy Summit on the Role of Performance-Based Building Regulations in Addressing Societal Expectations, International Policy, and Local Needs: Summit Report*, National Research Council, Washington, DC and Inter-jurisdictional Regulatory Collaboration Committee, Canberra, Australia, February 2004 (summary report, conference papers and presentations available at www.IRCCbuildingregulations.org).

[10] See www.ueatc.com

[11] See www.wftao.com

[12] Extracted from Bergeron, D., "Codes for Existing Buildings: Different Approaches for Different Countries," Proceedings, *7th SFPE International Conference on Performance-Based Codes and Fire Safety Design*, SFPE, Auckland, New Zealand, 2008.

the age and condition of the existing building stock, respect for the cultural and social environment, legal and civil rights of owners and occupants, historical and cultural significance, and potentially significant costs associated with significant modifications.

Recognizing that it is often impossible to directly apply requirements intended for new construction to an existing building, most countries will allow flexibility in the choice of solutions to achieve the building regulatory goals. In these cases, it is typical that the performance expectations for existing buildings do not have to meet the performance expectations for new construction. This can be difficult to regulate in a prescriptive environment – with the range of options currently in use running from no guidance to specific codes for existing buildings. Where performance goals, objectives and requirements are missing, and decisions are made on a one-off basis, there can be significant variability in how performance is assessed and in the levels of performance allowed in the existing building stock. However, where a functional or performance based approach is well established for new construction, there already exists a clear set of functional and performance objectives, a culture which accepts the use of risk assessment and other decision-making tools to determine the acceptable level of performance of solutions for existing buildings, and offers the ability to better understand and regulate for a desired level of performance.

2.0 THE COMPONENTS OF A PERFORMANCE-BASED SYSTEM

The IRCC is committed to the concept of performance based building regulations. However, we recognize that not all cultures, societies and legal structures are the same, and therefore a singularly universal performance based building regulation system is not practicable. However, there is a set of fundamental technical principles which underscore performance based building regulations, are common to all IRCC members, and where consistency is regarded as essential to a performance based system. These principles are discussed below. To illustrate how these principles have been implemented, a list of legal practices is also provided. The legal practices reflect issues where members have adopted different processes to achieve the principles, often determined by the legal structure of the member country. See Annex B for details.

2.1 COMMON DEFINITIONS RELATED TO PERFORMANCE SYSTEMS

Acceptable Solution (Approved Document, Deemed-to-Comply): A solution that has been determined by the authority having jurisdiction (AHJ) to comply with the *societal goals*, *functional objectives* and *performance requirements* stated within a *performance-based regulation*. These may be specific *prescribed/specified* solutions, provided in or referenced by the regulation, or *performance-based* solutions derived using *verification methods* provided in or referenced by the regulation.

Alternative Solutions: A solution that differs, in part or in whole, from the solutions offered by the *acceptable solution* or *verification method*, but achieves compliance with the performance requirements of the building regulation to the satisfaction of the AHJ.

Approved Method of Analysis: The process or method that is required to be followed for determining acceptability of an *alternative solution* when an *acceptable solution* or acceptable *verification method* is not applied.

Authority Having Jurisdiction (AHJ): That body deemed by government to have jurisdiction over building consent / approval within a particular jurisdiction (building consent authority, building control officer, building code official, fire code official, territorial authority, etc.).

Descriptive (Prescriptive) Requirement: A requirement expressed using definitions, particular (product) types or classes, or design features.

Function-Based: Being described in terms of the function intended to be achieved through the use of a material, product, component or system.

Functional Objective: A statement of how a building or its systems function to meet a *societal goal* for the building.

Functional Requirement: A requirement expressed using only *qualitative* terms, and stating a goal or objective which shall be achieved (e.g., “buildings shall have escape routes which allow users to leave the building sufficiently quickly and safely, taking into consideration its purpose and size, and whether emergency equipment can be used”).

Guidelines: Non-regulatory documents which supplement performance-based building codes or regulations, explaining the requirements in more detail and setting out procedures for the documentation of compliance.

Objective: Goal or objectives the building must achieve.

Objective-Based: Being described in terms of an objective or intent to be achieved through the use of a material, product, component or system.

Prescriptive-(Specification-) Based: Being *prescribed* or *specified* in terms of dimensions, materials installation or operation.

Performance-Based: Being described in terms of the performance of a material, product, component or system which can be measured, calculated, or predicted.

Performance-Based Building Regulatory System: A regulatory framework for the built environment which consists of 1) a *performance-based regulation* (code), 2) *acceptable solutions*, 3) *verification methods*, and *approved methods of analysis*.

Performance-Based Regulation (Code): A document that expresses requirements for a building or building system, in terms of *societal goals, functional objectives* and *performance requirements,* without specifying a single means for complying with the requirements. *Acceptable solutions* and *verification methods* for demonstrating compliance with code requirements shall be referenced by the code. (This definition also applies to *objective-based regulation (code).)*

Performance Criteria: *Quantitative* metrics against which building materials, assemblies, systems, components, design factors and construction methods will be evaluated on their ability to meet specific *performance requirements* by calculation, testing or simulation (application of *verification methods*). For example, tenability limits, escape time, structural loads, energy loads, that must not be exceeded.

Performance Requirement: A requirement expressed using *quantitative* terms, and the fulfillment of which can be determined by calculation, testing or simulation (application of *verification methods*). Performance requirements should provide the basis for evaluating how the building design and features will meet the *societal goals* and *functional objectives*.

Qualitative Requirement: A requirement which is stated in qualitative or descriptive language, typically relating to the quality or character of something, rather than to its size or quantity.

Quantitative (Requirement): A requirement which is capable of being expressed in numerical terms or estimated, measured or predicted using a *verification method* or other method deemed acceptable by recognized *guidelines* and *approved methods of analysis*.

Risk-Informed: Method or technique which considers qualitative and quantitative risk information as an input to a decision-making process.

Societal Goal: Broad policy statement that reflects society's expectation of the level of health, safety, welfare (see section 2.2.1) or amenity provided in a building. These statements, although generally qualitative, should be stated in such a manner that compliance with the goal can be evaluated using *acceptable solutions*.

Verification Methods: Calculation, simulation or test methods that prescribe one way to comply with the building regulation. Verification methods can include: calculation methods, using recognized analytical methods and mathematical models; laboratory tests, using tests (sometimes to destruction) on prototype components and systems; tests-in-situ, which may involve examination of plans and verification by test, where compliance with specified numbers, dimensions or locations is required (non- destructive tests, such as pipe pressure tests, are also included).

2.2 TECHNICAL PRINCIPLES FOR BUILDING REGULATION

2.2.1 FUNCTION OR PERFORMANCE, NOT PRESCRIPTION

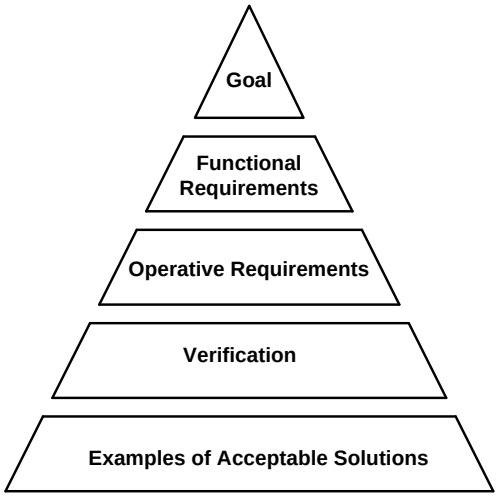
The key distinguishing factor of the IRCC is the commitment by members to develop building regulations which are based on functional or performance requirements. Instead of specifying what must be built and how, building regulatory requirements are given in the form of function that the building must fulfill and how this will perform and be assessed (performance).

As discussed in Section 1, building regulations are legal instruments intended to ensure that buildings, when constructed in accordance with the regulations, provide socially acceptable levels of health, safety, welfare and amenity for building occupants and for the community in which the building is located. Increasingly, these objectives are being expanded to include energy / resource efficiency, sustainability, and in some cases, wellbeing of building occupants.

These socially acceptable levels of performance were traditionally embodied in a large collection of prescriptive specifications that dictated how a building must be built, including what materials may be used, how they may be used, and when they may be accepted by approval authorities. Although generally helpful to enforcement officials when reviewing plans and inspecting construction for compliance with the specifications for buildings that matched the prescriptions, problems arose when buildings designs, materials and methods were unique, innovative, or otherwise different from that which was envisioned by the specifications.

Starting in the late 1970s, however, regulatory agencies of all types, and in many parts of the world, began to reconsider the traditional prescriptive approach to regulations, seeking ways to clarify the intent of regulation, reduce regulatory burden, and encourage innovation without compromising the level(s) of performance delivered. This gave rise to consideration of *functional, objective-based* or *performance-based* approaches to regulation. In the building regulatory environment, the hierarchy outlined by the Nordic Committee on Building Regulation (NKB) became a widely adopted model.

In the NKB model,[4, 13] the regulatory provisions are based on a set of broad *societal goals* – essential interests of the community at large with regard to the built environment – and through increasing levels of detail, functional and operational requirements for buildings are described (*functional requirements* being qualitative requirements of buildings or specific building elements, and *operative requirements* being actual (quantitative) requirements, in terms of performance criteria or expanded functional descriptions). Instead of prescribing a single set of design specifications for compliance, the approach outlines the need for *verification methods* – instructions or guidelines for verification of compliance – which could include engineering analyses, test methods, etc, and would be used to demonstrate compliance with the operative requirements, as well as examples of *acceptable solutions* – supplements to the regulations with examples of solutions deemed to satisfy the requirements – which may be prescriptive. The NKB model is attractive because it places the focus on societal (policy-level) goals and allows for a variety of forms of regulatory provisions to provide the detail required to demonstrate compliance, specifically function-based, objective-based, or performance-based.



NKB Model (NKB, 1976)

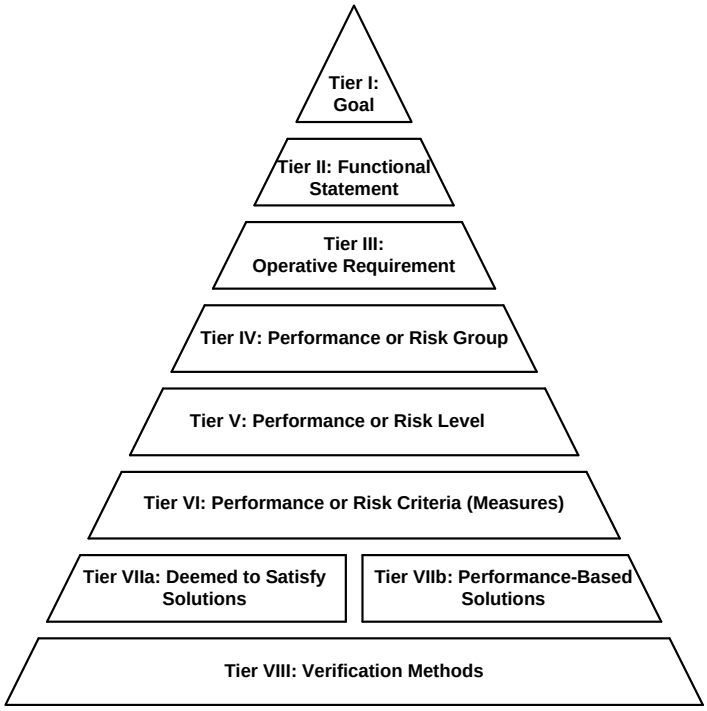
In essence, a *function-based* approach generally follows that the only requirements needed in the building regulation are policy-level goals and functional objectives which describe how the resulting building is intended to function at a very high level (e.g., a building shall be designed and protected such that all occupants not intimate with the first materials burning shall be able to safely evacuate the building). This approach does not specify how the functional objective is to be met, which allows significant flexibility in solutions. However, it also typically does not provide quantitative criteria against which to assess the suitability of a building design in meeting the functional objective. As a result, the acceptable solutions are often widely applied.

An *objective-based* approach takes the functional concept a bit deeper, providing more specific objectives (operative requirements) – often qualitative, but readily linked to acceptable solutions. This approach has been taken when a country has felt that the performance requirements are embodied adequately in the acceptable solutions, but the timing or capability is not yet right to extract the specific performance measures into the regulation (e.g., see the Canadian experience). Although qualitative, these objectives provide additional guidance for assessing the suitability of alternate solutions to the acceptable solutions.

Finally, a *performance-based* approach goes one step further and defines performance requirements (objectives) which can be clearly identified, articulated, and quantified, and

[13] NKB (1976). Nordic Committee on Building Regulations (NKB), *Programme of Work for the NKB*, Report No. 28, Stockholm.

which serve as the basis against which compliance with the regulation is assessed (e.g., see the Australian, the Dutch or the New Zealand experience). In its most complete form, a performance-based approach includes acceptance (performance) criteria – which can be quantified, measured, and/or calculated – and verification methods – which together serve as the metrics and methods for demonstrating compliance (e.g., see Japan experience). Ultimately, this ability to quantify performance criteria and connect them to specific verification methods is essential, as it serves as the basis for testing, design and evaluation. This approach assumes that suitable technology exists for the establishment of performance criteria, and for evaluation of materials, products, systems and designs against the criteria, and is the target for many countries.

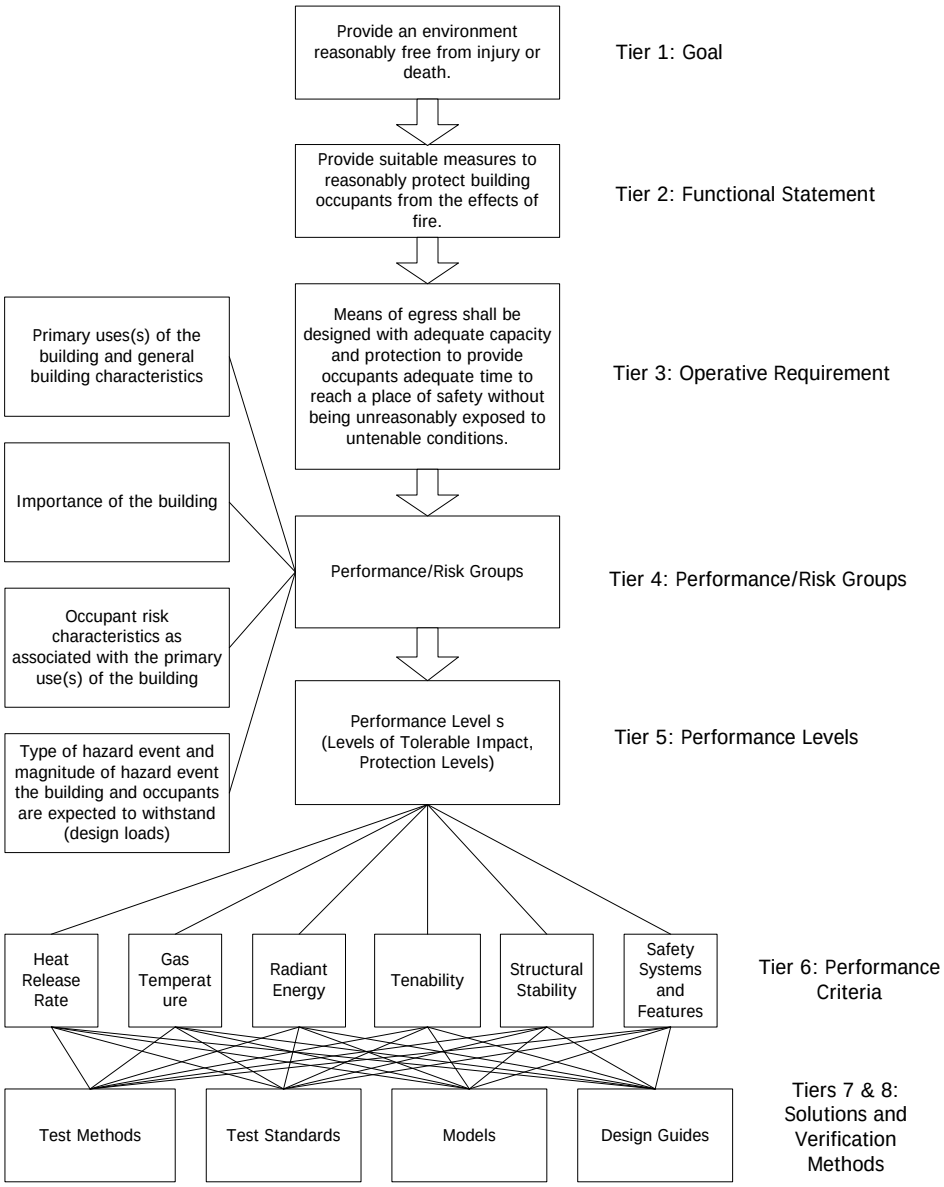


Over the past several years, experience with functional, objective-based and performance-based building regulations has indicated that although the approach provides increased flexibility and innovation in the market, more detail can be helpful in the regulatory system, particularly in terms of describing the level(s) of performance (or risk) that buildings are intended to achieve over a wide range of conditions, and to better describe the criteria or measures against which successful performance will be evaluated. Discussion around better understanding how performance targets can be established in relation to the levels of risk, safety and performance the public expects, and why quantified performance criteria can be useful in assessing how different attributes of the building perform in relation to one another, resulted in an evolution of the NKB Model into the eight-tier IRCC Model.[14] The IRCC model reflects additional levels for *performance or risk group*, *performance or risk level*, and *performance or risk criteria* (measures). These tiers were added to the NKB model to illustrate how factors such as levels of tolerable building performance or risk, and importance of a building category to the community, are reflected in goals, functional requirements, and operative (performance) requirements.[15, 16, 17] With these added tiers,

[14] Developed during an IRCC working meeting in Edinburgh, Scotland, October 1998, the model was modified by Meacham to illustrate the interactions of the tiers with respect to a fire safety problem (Meacham, 1999) and has been subsequently used to illustrate various interactions between objectives and criteria, the role of risk and performance levels, and interaction between methods of verification for different performance metrics (e.g., see Beller, Foliente and Meacham, 2002; Meacham, 2004).

[15] Meacham, B. (1999). "Fire Safety Analysis and Design in a Performance Based Regulatory System," *Proceedings of the Global Building Model in the Next Millennium Convention*, Building Control Commission, Melbourne, Victoria, Australia, pp.187-201.

the IRCC hierarchy is also better able to illustrate how test methods and standards, evaluation methods, design guides, and other verification methods can be used to demonstrate compliance. This is illustrated in the following representation of the IRCC model, which is based on linkages related to a safety objective related to safe egress in the event of fire (Meacham, 1999).



It should be noted that eight tiers can be used to introduce and discuss concepts important to a performance-based regulatory system. In practice, there may be more or less than eight tiers in a regulatory system, depending on local or national needs, legal structure or other such influences, as discussed in subsequent sections.

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[16] Meacham, B.J. (2004). "Performance-Based Building Regulatory Systems: Structure, Hierarchy and Linkages," *Journal of the Structural Engineering Society of New Zealand*, Vol. 17, No. 1, pp. 37-51.
[17] Meacham, B.J., Moore, A., Bowen, R. and Traw, J. (2005). "Performance-Based Building Regulation: Current Situation and Future Needs," *Building Research and Information*, Vol. 33, No. 1, pp.91-106.

2.2.2 MINIMUM, NOT ASPIRATIONAL

Building regulations require compliance by legal enforcement and constitute a minimum level of functionality or performance: it is legally not possible to build lower than this level, and the legal target should not be any higher.

In most countries, the public expects government to assure that mechanisms are in place to address minimum social needs, such as sanitary facilities, potable water, and reasonable safety and accommodation. Each government will decide what the specific social needs are, and under what conditions they are to be provided, and through building regulation will establish the minimum level of building function and performance that is legally enforceable under building legislation. As such, building regulation cannot represent levels of functionality or performance to which the industry, society or the general public aspire, since aspirational goals and objectives could be very hard to agree, difficult to enforce, and could place unreasonable pressures on society which can be better addressed through the market.

Regulated minimums serve to help the public understand what is required from buildings and to help the market identify opportunities to meet public desires which are over and above those minimums. If a society views a person's home as their castle, and confers upon the homeowner a high degree of flexibility in managing the household operations and risks, initial affordability may play a key role in establishing minimum requirements, leaving the homeowner to address risk and operational management through the market as appropriate to their desires and means (beyond minimum health, safety and welfare requirements in the regulation). Likewise, in a commercial environment, if a facility owner or tenant understands the minimum hazard protection being provided and under what conditions, they have a basis from which to make informed decisions as to risk acceptability or the need to take on additional risk management mechanisms.

Which aspect(s) of a functional or performance regulation that is enforceable (referring to the IRCC model) varies by country (see Section 2.3). In Australia, for example, the performance requirements (Tier III) reside in the building regulations and are legally enforceable while the functional objectives (Tier II) are advisory, whereas in England, the functional objectives are in the regulation and are legally enforceable.

As new pressures and threats impinge on society, there may be a desire to increase the level of building functionality or performance over a wide range of areas, from occupant accessibility and egress, to energy efficiency, to risk mitigation. In such cases, other types of legislation may exist which already address the issue, or voluntary guidelines, which are aspirational in nature, can often fulfill market needs more efficiently than changes to building regulation. It should also be noted that while building regulations must be legally enforceable, it is essential that they are supplemented by guidance which outlines how compliance can be achieved, as outlined above. Such guidance might be performance- or prescriptive-based, and some may have legal status (e.g., acceptable solutions), while some may be more voluntary in nature (e.g., engineering guidelines). However, under a functional or performance system, such guidance may not be enforceable, and flexibility in means to

demonstrate compliance remains with the party that is required to comply with building regulations.

2.2.3 OBJECTIVE, NOT SUBJECTIVE

Building regulations confine themselves to objective issues which can be tested and verified by established methods, and do not involve subjective issues which are determined by popular opinion.

Building regulations are concerned with technical issues – not aesthetic issues – and therefore do not normally cover issues of appearance and taste. In many countries, aesthetic issues are typically a function of local planning (zoning) legislation and requirements, as well as cultural or heritage protection legislation.

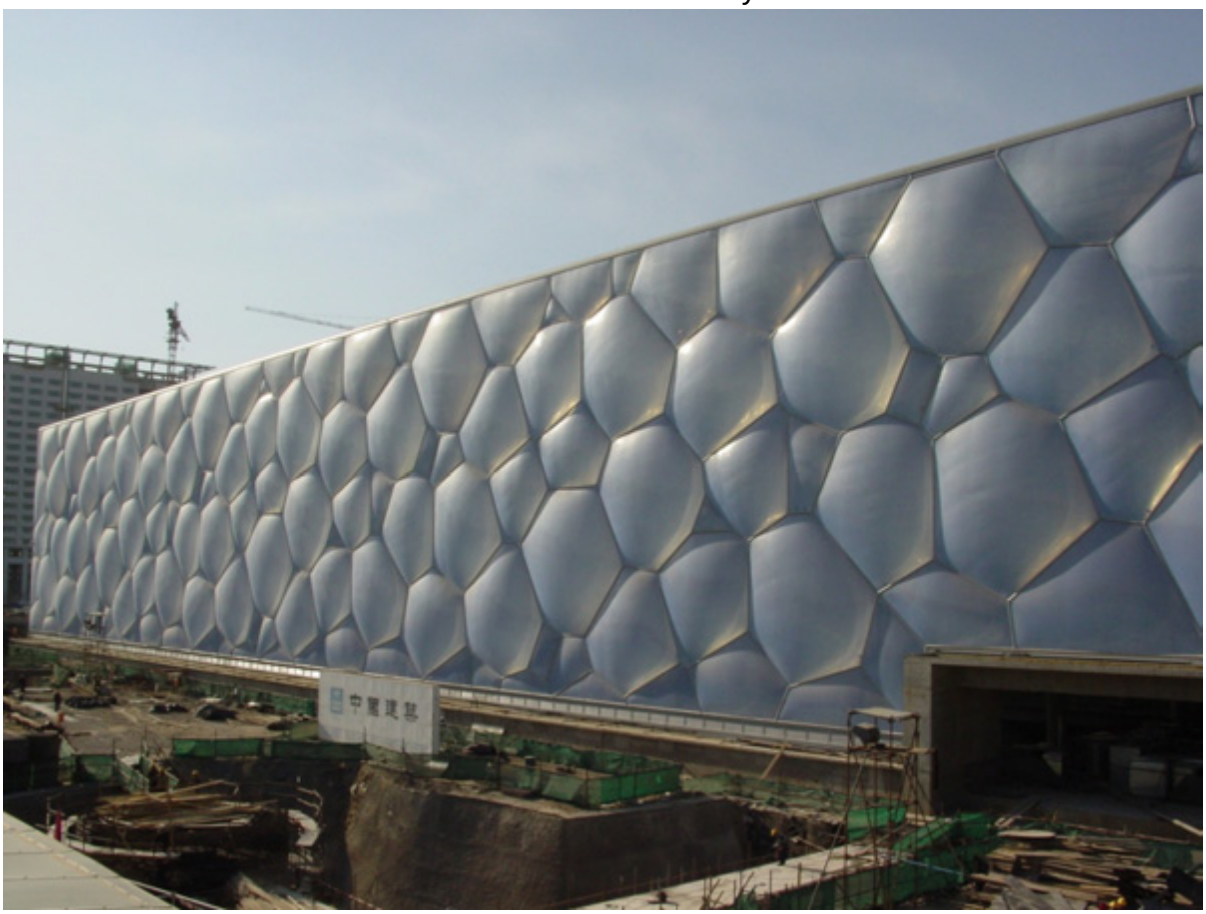
This is not to say that governing legislation does not overlap (which it does, in some cases causing competing objectives which need to be addressed), but that the building regulation must remain focused on the minimum *technical* objectives for buildings as deemed appropriate within a particular country. For example, building regulation is not concerned with the color or appearance of external cladding or façade, but may be concerned with the performance of the cladding or façade with respect to moisture penetration or energy efficiency. Likewise, building regulation is not concerned with the appearance of an external door, but is concerned with the accessibility to and through the doorway and the capacity to support safe egress.

Potentially competing objectives are typically most evident with existing buildings, but may be present when new construction is being proposed in an area protected under heritage or cultural protection legislation. For example, heritage or cultural legislation may require all buildings in a particular section of a city to have a monumental staircase leading from a sidewalk at grade to the primary entrance/exit at the front of the building. Although aesthetically pleasing, the design may not be accessible for persons with mobility impairments, or may somehow impede safe egress, and may therefore not be allowable under the building regulation (unless alternate provisions for access and egress are provided). In such a case, it is the role of building regulation to assure that appropriate means of access and egress are available, regardless of such concerns as the appearance or fit of the building into the local environment. As discussed earlier in this document, however, functional- or performance-based regulation can help bridge gaps which may exist between competing legislation, since the focus on function provides more flexibility in delivering solutions than does a highly prescriptive regulation.

2.2.4 PRODUCT, NOT PROCESS

Building regulations are concerned with the product of the building process – the finished building – not on processes related to how the construction is carried out.

The building regulatory process has many components, of which the building regulation itself is just one. There are numerous other regulations and governing legislation that have an impact on buildings, including planning, environmental and resource management, and construction safety (occupational health and safety). It is necessary and appropriate to understand the limits in scope related to the building regulation and avoid unwarranted cross-over that may result in competing objectives. These issues will be addressed in different ways in different countries. In some they will be linked to the building regulations in others dealt with by separate legislation and separate enforcement authorities. For example, issues of construction worker health and safety on building sites are not typically considered part of the building regulations, but are ordinarily addressed under occupational health and safety legislation. Building regulations also typically do not describe construction processes or practices that must be undertaken to build a structure. Control over the process of construction or demolition is typically outside of the scope of the building regulation. This is not to say that the building regulation cannot have an objective that states that construction or demolition must be done safely.



2.3 LEGAL PRACTICES

Given the diversity in government structures, from strong central governments to federations of states, it should come as no surprise that there is also a wide diversity in the development, promulgation and enforcement of building regulations. This section briefly outlines a range of building regulatory development, promulgation and enforcement attributes, with summary tables indicating the situation in IRCC member countries. Annex B provides a more extensive discussion of the system attributes and IRCC member situations.

2.3.1 DEVELOPMENT ROUTES VARY, BUT PROMULGATION IS BY GOVERNMENT

The development of building regulation varies from governments, to organizations working for government, to the private sector, but adoption and promulgation is always by a government entity.

Development by National Government	Development by Regional Government	Development by Local Government	Development by Organization working for Government	Development by Private Sector
China, England, Japan, New Zealand, Norway, the Netherlands Scotland, Singapore, Spain, Sweden	Austria,[18] USA[19]	USA	Austria, Australia, Canada	USA

Development by government can be at the national, regional or local level. The level at which building regulations are developed is a function of the governmental structure and associated responsibilities, enabling Acts and legislation. The responsibility may be granted by royal decree, constitution, charter or similar mechanism. In some countries, responsibility for building regulatory development is designated to entities working on behalf of the government. These entities may be government-supported research institutes, organizations established for the purpose via intergovernmental agreement, or other duly-designated organizations. This situation is typical in federations of states, territories or provinces.

Building code development can also be carried out in the private sector via organizations which are working for the public good, and whose members include building regulatory and enforcement personnel for governments at various levels. In most cases public consultation or comment periods are provided, regardless of who drafts the initial documents, in order to obtain feedback and buy-in from the building industry, the public, and other interested and affected stakeholders.

[18] Austria is in transition from a regional government development to development by an organization working for government.

[19] In the United States, each state has responsibility for building regulation, and can permit local municipalities to develop and promulgate building regulations, but most jurisdictions adopt a model building code developed by a private sector organization.

2.3.2 PROMULGATION NATIONALLY, REGIONALLY, LOCALLY OR IN COMBINATION

Building regulations can be promulgated at a national, regional or local level. The authority for promulgating building regulation is diverse, ranging from constitutionally-delegated or derived authority, to agreement between different levels of government and sometimes industry.

Promulgated by National Government	Promulgated by Regional Government	Promulgated by Regional and Local Government
China, England, Japan, New Zealand, the Netherlands Norway, Scotland, Singapore, Spain, Sweden	Austria, Australia	Canada, USA

The different structures have a number of advantages and disadvantages, which are explored through reference to the situation in various IRCC member countries.

Characteristics of Different Approaches

Nationally Promulgated

Whether developed by central government or other, a nationally-consistent set of building regulations and related standards provides strong advantages in terms of uniformity in delivery, certainty in the market (for designers, suppliers, contractors), and consumer confidence. For the construction industry and manufacturers of building products, nationally set regulation means they do not have to alter products, design or construction methods to suit various requirements. The construction industry also benefits because the provisions have been subjected to a rigorous review and assessment process with input from industry. Local regulatory and enforcement authorities benefit because they need not develop their own technical standards and can take advantage of national/international research and contemporary developments. National regulation means consumers can expect the same level of building performance throughout the country. These advantages are supported by the discretionary provisions which can be used by municipal authorities in cases where it is impractical or unnecessary to comply with certain provisions of the building regulations, which may not be applicable due to local conditions. Also provisions which allow authorities to exempt building work where they can see that the building work is low risk or minor and any potential benefits from having inspection and compliance checks are outweighed by the associated cost.

Regionally or Locally Promulgated

The principal advantages of regionally promulgated systems are evident in countries with a broad diversity of geological and climatic conditions, which allow for local governments to implement only those provisions which are locally pertinent. In countries where there are distinct regions of high seismicity, hurricane or cyclonic potential, snow and ice loading, and riverine flooding, and the hazards do not overlap, a single building regulation system could

have numerous unnecessary provisions that must be omitted by exception if not applicable. A system which allows for regional requirements only could result in lower regulatory burden.

2.3.3 VERIFICATION REGIMES VARY

As discussed in Section 1.1, building regulation is not a code of good practice or a voluntary undertaking made by building owners, but is a mandatory, legal instrument for the protection of the general public, and therefore requires compliance by legal enforcement. How compliance is enforced and verified, however, can vary significantly. It can be through public bodies, through private companies licensed in some way by the government; it can be done through professional institutions that are given some form of public recognition.

Verification by Government (Review and Approval)	Verification by Government / Licensed Practitioners / Designated Private Bodies (Review and Approval)	Verification by Private Design Companies (Licensing / Quality Control for Self-Certification)
Austria, the Netherlands, Scotland, Singapore, USA	Australia, Canada, China, England, Japan, New Zealand[20]	Norway, Spain, Sweden

Verification can also take a number of forms. It may be an assessment of the designs or of the competence of the builders. It may occur before design work begins, before construction starts or before occupation of the building. It should also be noted that verification regimes of governments may also include confirmations from licensed practitioners, which constitutes an intermediate approach. The common principle however is a legal requirement for independent verification of compliance in some form or at some stage.

2.3.4 STAGE IN THE BUILDING PROCESS WHERE VERIFICATION OCCURS VARIES

Although all building regulatory systems will require some form of verification, the stage at which this is given can vary between members. If the verification is of proposed buildings then it might occur before work starts on site, or during the building process. If the verification is of individuals who will be allowed to undertake work then it might occur on a project-by-project basis, or at fixed time periods throughout a career.

[20] Building owners are required to provide annual warrants of fitness for specific systems.

Qualification of Practitioners only (Licensing / Quality Control – no Design Verification)	Verification at Time of Design	Verification at Time of Design, During Construction, At Occupancy	Verification at Design and throughout Building Life
Norway, Spain, Sweden	Austria[21]	Australia, Canada, England, Japan, the Netherlands, Scotland, USA	China, New Zealand[22], Singapore

The level of verification and qualification of verifiers also varies, often by the complexity of the building, but in some cases based on the form of verification or approval. Verification to 'acceptable solutions' may be less involved than verification of performance-based or alternative solutions, and require less in terms of professional qualification (based on comparison against a document in contrast to verification of engineering analysis and design calculations). In some cases expert peer review is encouraged or required.

2.3.5 DISPUTE RESOLUTION VARIES

Any performance system introduces a degree of assessment as to the extent of compliance. Unlike a prescriptive system where this might be resolved by simple measurements, a performance-based system will rely more on expertise, education and understanding of the principles behind specific regulations. Therefore there needs to be some form of established mechanism to ensure that where differences of opinion occur regarding compliance with building regulations, these can be resolved quickly and accurately.

Government Authority Having Jurisdiction	Negotiation	Courts	Appointed Body	Progression from AHJ through Appeals to Courts
England, New Zealand, The Netherlands, Norway, Singapore	China	Scotland, Spain, Sweden	Japan	Australia, Austria, Canada, USA

There is a significant range in dispute resolution amongst the IRCC member countries, from contract negotiation, to within the relevant governmental authority (local, regional or national), to a progression from negotiation, to governmental appeal, to judiciary appeal. In some countries disputes go directly to government appointed bodies or into the judiciary.

[21] Some site verification is required for complex projects.
[22] Building owners are required to provide annual warrants of fitness for specific systems.

2.3.6 DUTY HOLDERS VARY

Building regulations apply to buildings, but will impose duties of compliance on different groups of people. Groups who may be involved include owners, occupiers, tenants, designers, builders, specialists, verification checkers, insurers, standards organizations, regulators.

Principally the Building Owner	Principally Design Professional	Duty holders determined by Regional Government	Multiple Stakeholders
Austria, Scotland, Sweden, The Netherlands, USA	Norway	Australia	Canada, China, England, Japan, New Zealand, Singapore, Spain

Understanding that there are many entities with duties and responsibilities in each country (see Annex B), it is interesting to note those countries wherein specific stakeholders bear more responsibilities than others, and in all cases, how the apportioning is determined.

2.3.7 APPLICATION TO EXISTING BUILDINGS VARIES

Building regulations have traditionally been developed to apply to new construction. As a growing percentage of the construction activity is with the renovation, transformation, extension and upgrading of existing buildings more countries are engaged in developing regulatory tools for existing buildings.

Building Regulation Not Applicable to Existing Buildings	Building Regulation has Provisions for New and Existing Buildings	Application to Existing Buildings Determined by Regional Government	Application to Existing Buildings for Major Alteration or Renovation	Separate Regulation for Existing Buildings
Austria	China, England, the Netherlands, Singapore, Sweden	Australia	Canada, Japan, New Zealand, Scotland, Spain, Sweden, USA	USA

In 2007, the IRCC conducted a survey of member countries with respect to building regulation and existing buildings. A summary of the 2007 survey results was published in 2008 (Bergeron, 2008), and an extract from the paper is presented in Annex C.

Some of the key outcomes of the survey include the following:

- An important aspect of regulation for existing buildings is the determination of the performance level required from building upgrades. In many countries this is achieved by comparing existing building upgrades to the performance levels required for new construction;
- A fundamental difficulty encountered is the unavailability of sufficient knowledge to express the performance target of building regulations in quantified measurable terms that can be verified. Developing tools and methods to help develop these performance parameters is essential to the success of this approach; and
- In some countries the regulations make allowance for risk-based approaches for determining what constitutes an acceptable level of performance. With the rapid expansion of the scope of regulations from the traditional fire and safety issues, to emerging social objectives such as accessibility and resource conservation, new decision-making tools need to be developed to support this approach.

2.3.8 SCOPE AND CONTENT OF THE BUILDING REGULATION VARIES

Although most countries choose to cover approximately the same issues in their building regulations there is still significant variation. Some of this is due to difference in climatic or geological conditions, some is due to political priorities and some is due to sociological changes.

Structure, Fire, Environment, Safety, Noise	Energy	Accessibility	Wellbeing	Sustainability	Civil Engineering Works
Australia, Austria, Canada, China, England, Japan, the Netherlands, New Zealand, Norway, Scotland, Singapore, Spain, Sweden, USA	Australia, Austria, Canada, China, England, the Netherlands, New Zealand, Norway, Scotland, Singapore, Spain, Sweden, USA	Australia, Austria, Canada, China, England, New Zealand, Norway, Scotland, Singapore, Sweden, Spain, USA	New Zealand, Singapore,	the Netherlands, Scotland, Singapore,	Austria,[23] New Zealand, Norway, Singapore, Sweden

Most IRCC member countries address the following issues (see Annex B for details), drawn here from the CPD's six essential requirements:

Structure: Preventing collapse or deformation of the building and disproportionate collapse.

Fire: Essentially from a life safety perspective, considering means of escape, separation, fire spread, fire service requirements.

[23] Only for civil engineering works which are not covered by special federal legislation.

Environment: Considers harmful substances in the site, flooding, drainage (including final disposal from site), weather-proofing, sanitary facilities, ventilation, natural lighting, combustion appliances and fuel oil storage.

Safety: Covers access to and within buildings for all people, stairs, electrical works, limiting dangers from glazing and LPG gas storage.

Noise: Covers the design of walls and floors of dwellings resist airborne and impact sound transmission.

Energy: Considers methods of reducing energy use in buildings, covering the heated envelope, heating system, artificial lighting, air conditioning, commissioning services and energy performance certificates.

Beyond these six areas, there are varying degrees to which the scope of building regulation has grown to include protection of building contents, accessibility, amenity (well-being), and sustainability. More discussion on the scope within each country can be found in Annex B.

2.3.9 THE DEFINITION OF PUBLIC INTEREST VARIES

Building regulations are normally concerned with protecting the public interest rather than just that of the private individual. They are concerned about the health, safety and welfare of people who use buildings or who have to walk past them, rather than simply the protection of the building owner. The concept of protecting the general public has now been extended in many countries to protecting society as a whole from buildings which might affect them. This can be seen in inclusion of regulations to reduce the amount of carbon produced by buildings over their life and by the desire to ensure a flexible housing stock to cope with an aging population.

More on the breadth of public interest issues addressed within each member country can be found in Annex B.

3.0 TRANSFORMATION OF THE SYSTEM FROM PRESCRIPTIVE TO PERFORMANCE

As outlined in Section 1, there are a variety of reasons why a country may choose to transform their building regulations, and indeed their building regulatory system, from a predominantly prescriptive-based system to a predominantly performance-based one. However, simply identifying good reasons for such a change does not mean that the transformation will occur, or that it will be simple, or that it can happen instantaneously. Changing a building regulatory system is a public policy decision, and as such will be influenced by the political and legal system in place within a country, taking account of those inputs deemed important and those processes which are required within the system.

Although the policy making process will vary by country, the process in many countries can be characterized as having at least four components: (1) the setting of the agenda, (2) the specification of alternatives from which a choice is made, (3) an authoritative choice amongst the specified alternatives, and (4) the implementation of the decision (Kingdon, 1995). During this process, different players are likely to be involved at different times, each with different influences, and each working within different process streams: problems, policies, or politics.

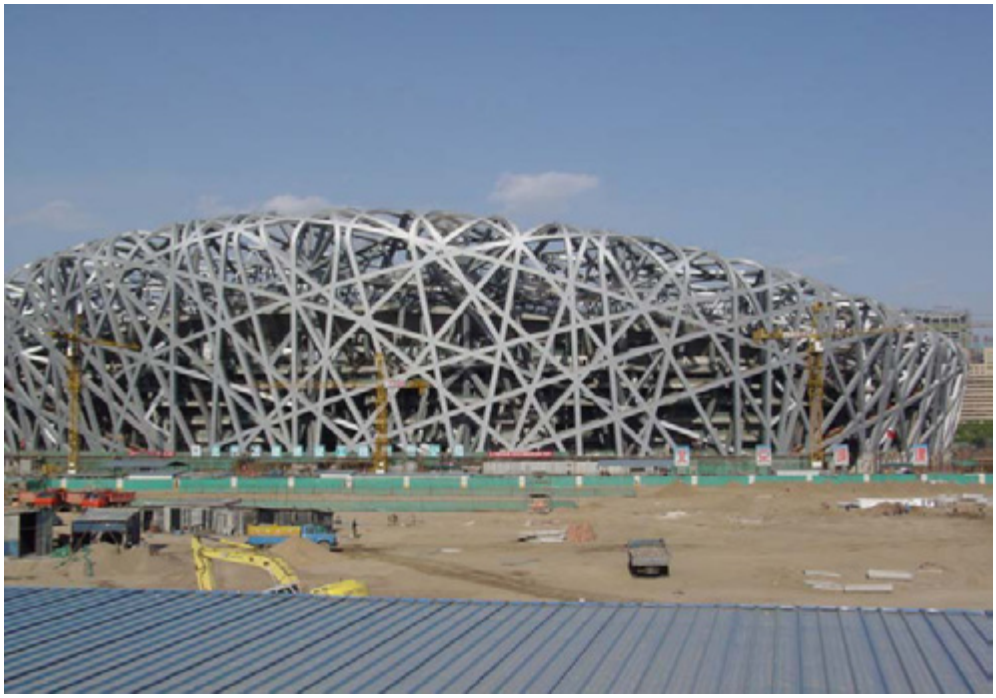
First, a condition or set of conditions needs to be recognized as a problem and pushed toward the agenda for action. Next, there needs to be a solution (or set of solutions) from which proposals for policy changes will be generated. Along the way, political activity will occur ranging from influencing the selection of a viable solution to making the final decision. For example, the leader of a nation, a Minister, member of Parliament, or other senior policy official may have a large role in setting the national agenda, based on indicators that there is a problem to address, but may be less influential in developing or specifying workable alternatives. Specialists, such as bureaucrats, academics, researchers, and interest groups, on the other hand, may not be as effective in setting the agenda, but are better poised to develop, test and propose alternatives, and can influence the selection of an alternative. Throughout the process, interest groups and policy entrepreneurs work the problem through the system, gaining attention and support. Decisions are made when the three independent streams (problems, policy and politics) intersect, and a policy window appears within which timely action can transpire.

We do not have to look very far to find examples of this process at work in influencing building regulations. Every major fire, earthquake or other extreme event prompts changes to the system. Global climate change and sustainability concerns are resulting in policy-driven targets for building performance for which technological solutions, implementation strategies, and performance measurement tools and methods may not yet exist.

The aim to provide the same level of access to the built environment for people of all abilities has prompted new thinking and approaches to building access, use and egress.

Many of these event outcomes and policy decisions translate into drivers for transformation to a performance-based building regulatory system, in addition to the drivers noted in Section 1, such as a desire to reduce the cost of regulation, leveling the playing field for movement of products and services between nations, to fix failures in the system, or simply to create an opportunity for better and more innovative buildings products, systems and designs.

This section provides brief overviews and discussion of the process and methods of changing from a prescriptive-based to a performance-based system within IRCC member countries. The story of the transformation is presented in a series of case studies from members of the IRCC, updating and building upon those in the 1998 IRCC document, and incorporating new stories from the newer member countries. Many of these stories not only discuss how the transformation was effected, but how successful it has been.



3.1 TRANSFORMATION OF THE SYSTEM – AUSTRALIA

HISTORY

From the mid 1960s, attempts were made to have a building code agreed between the eight Australian States and Territories. In 1965, a draft model code emerged called the Australian Model Uniform Building Code, the forerunner to the current national Building Code of Australia (BCA). While the earlier code was not referenced in State and Territory regulation, it was used as a basis for regulation though many variations existed. By the early 1990s, the cost impact of the regulatory burden on building affordability for the community was a concern. It was also evident that the competitiveness of the building and construction industry was constrained by differing regulatory requirements across Australia, and prescriptive standards that discriminated against new products and technology. Ministers strongly supported the view that wherever possible, their States' legislation should draw upon a common set of technical data, and that the building regulations needed to be performance-based, scientifically robust, and developed with strong industry and professional input. The result was the creation of the ABCB, through an Intergovernmental Agreement (IGA) signed in March 1994 by all governments (and reaffirmed in April 2006), to develop and maintain the BCA and to lead regulatory reform.

ABOUT THE AUSTRALIAN BUILDING CODES BOARD (ABCB)

The ABCB is a jointly funded arrangement between the Commonwealth, States and Territories. The ABCB is responsible for developing a nationally consistent building code, the BCA, based on minimum necessary regulation. The Board's mission is "…to address issues relating to health, safety, amenity and sustainability by providing for efficiency in the design, construction and performance of buildings through the BCA and the development of effective regulatory systems." The BCA is model regulation, which is referenced in State and Territory building legislation. The BCA is a performance-based code. While offering prescriptive solutions ("deemed-to-satisfy") to meet performance requirements, the BCA also permits other solutions that satisfy BCA performance requirements. Basing the BCA on performance, therefore, gives industry greater opportunity to develop innovative, cost effective solutions.

The ABCB has substantially reduced BCA variations since 1990 as part of an internationally regarded approach to building regulatory reform. Key regulatory reform outcomes by the ABCB over the last ten years include:

- National performance-based building code, the BCA, operating since 1997;
- Contestable certification services for building approvals in most states;
- Introduction of a rigorous economic evaluation approach to regulatory change;
- National product certification scheme;
- National accreditation framework for building certifiers; and
- Australia's first national energy code for houses and commercial buildings in the BCA.

These initiatives continue to have significant benefits for the community and industry through cost savings in design and construction, more efficient services and on-going life-safety, health and amenity for people in buildings.

The Board's Role

The ABCB Board consists of an independent Chairman, four industry representatives, an Australian Government representative, senior executives responsible for building regulatory matters from all State and Territory Governments, and a local government representative. Board members are appointed by Ministers. The Board is responsible for the strategic oversight and direction of the regulatory reform program, policy development and direction, priorities and budget and financial control. The Board reports directly to the Australian Government Minister and State and Territory Ministers responsible for building regulatory matters. Under the IGA, State and Territory ministers responsible for building regulation have agreed to meet periodically to review outcomes and progress against the objectives of the IGA and the Annual Business Plan, and review the annual reports. The Board provides a vital link for the building industry between building practice and government building regulatory policy. It is also a catalyst for regulatory reform and seeks to balance the competing views of all stakeholders involved in the building and construction industry, including the community. The Board:

- Sets minimum technical building requirements, standards and regulatory systems that are nationally consistent between States and Territories and which are cost-effective, performance-based and facilitate modern and efficient building practices;
- Ensures that the BCA is maintained and continues to meet the ABCB's objectives of health, safety, amenity and sustainability in buildings;
- Performs a regulatory "gatekeeper" role and to examine and promote opportunities to reduce regulatory burden;
- Undertakes and encourages innovative research and development within the industry to ensure a world-class performance-based building code;
- Consults with Government, industry and the community to achieve transparency in the regulation reform process;
- Simplifies the wording of the BCA requirements to achieve user-friendliness;
- Coordinates reform activities with other agencies to ensure consistency and encourage consolidation into the BCA of all mandatory requirements affecting buildings;
- Promotes national consistency in building regulations;

- Facilitates an efficient regulatory environment leading to an internationally competitive building and construction industry; and
- Undertakes education and marketing activities to increase awareness of building regulatory reform and to enhance the use of Board publications and products.

The ABCB Office

The ABCB Office is a professional, technical and administrative unit that supports the Board's work program. This multi-disciplinary group's responsibilities include:

- Technical support services;
- Management of research projects;
- Consultation with industry;
- Advice on policy development;
- Management and coordination of committee activities;
- Awareness and communication activities; and
- Administrative and operational support including financial management.

Building Codes Committee

The Building Codes Committee (BCC) is the Board's peak technical advisory body. The responsibilities of the BCC are to advise and make recommendations, through the Chair, to the Board on technical matters relevant to the BCA, strategic policy relevant to building control matters, and a list of categorized and prioritized proposals to assist in the development of the ABCB Annual Business Plan. The BCC also provides advice and guidance to the BCA Office at key stages of technical projects and on the overall direction and development process for technical projects through the review and endorsement of Project Management Briefs.

Joint Building and Planning Working Group

The Joint Building and Planning Working Group is a collaborative working committee of the Board which includes representatives of government and industry. Its role is to make recommendations on the overlap and duplication of building and planning regimes and climate change and sustainability in the built environment.

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3.2 TRANSFORMATION OF THE SYSTEM – AUSTRIA

HISTORY

Austria is a federal state, and the building regulations are issued by each federal province independently. At present, the existing building regulations of the nine federal provinces are all structured in different ways, with requirements distributed in a hierarchical way amongst laws and ordinances. These requirements include functional requirements, performance requirements and prescriptive requirements in different ways and proportions.

The building regulatory system is currently in the process of being changed. In the future the requirements will be purely functional and harmonized at the level of provincial laws. Detailed requirements will be set in so called "OIB-guidelines," issued by the Austrian Institute of Construction Engineering (OIB). Most of the provinces will refer directly to these OIB-guidelines.

In drafting the OIB-guidelines, the principles of performance based building regulations have been taken into account as far as possible. Nevertheless, the first generation of these guidelines will include a mix of performance based and prescriptive requirements, in order to insure a certain continuity in the practical application of building regulations in the Austrian provinces. It is envisaged to replace the remaining prescriptive requirements with performance-based requirements, in a step-by-step manner, in future editions of the OIB-guidelines. Revisions will be made approximately every three to five years.

ABOUT THE AUSTRIAN INSTITUTE OF CONSTRUCTION ENGINEERING (ÖSTERREICHISCHES INSTITUT FÜR BAUTECHNIK,OIB)

The Austrian Institute for Building Construction (OIB) provides technical coordination within Austria in the area of the regulation and guidance for the building industry. In particular, OIB issues the above mentioned OIB-guidelines, is the accreditation authority for the construction sector and European Technical Approval body, providing a resource for the assessment of construction products.

Photo from Online Archiv Innsbruck Tourismus www.innsbruckphoto.at

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3.3 TRANSFORMATION OF THE SYSTEM – CANADA

HISTORY

The first National Building Code of Canada was published in 1941. As preparations were underway for publication of the 1995 National Code Documents—National Building Code (NBC), National Fire Code (NFC) and National Plumbing Code (NPC)—the Canadian Commission on Building and Fire Codes (CCBFC)[24] decided that it would be good to step back and examine its current state and where it was headed. A task group was formed to develop a strategic plan[25] to guide the next ten years of the Commission's work. In the task group recommended improvements to the Codes, four themes emerged:

- The scope of the Codes needs to be clearer;
- The intent behind code requirements should be clearer;
- The Codes should be more accommodating to innovation; and
- The Codes should be easier to apply to renovation.

It is generally perceived that prescriptive requirements inhibit innovation whereas performance requirements are much more accommodating to innovation. Therefore, the CCBFC assisted by NRC staff began to investigate the feasibility of converting the model National Code Documents to a performance-based format.

EVOLUTION OF THE OBJECTIVE-BASED CODES CONCEPT

Participation in CIB Task Group 11, Performance-Based Building Codes and IRCC permitted NRC staff to learn and pass on to the CCBFC the experiences of those countries that had adopted performance-based codes. This convinced the CCBFC that rapid conversion of the model National Code Documents to a performance-based format would be extremely disruptive to the Canadian construction industry and regulatory community. A more

[24] The CCBFC is a committee of 40 +/- volunteers from across Canada and from all segments of the community affected by the National Code Documents—consumer representatives, architects, engineers, building officials, fire officials, plumbing officials, material suppliers, builders, etc. The CCBFC makes all the decisions regarding the content of the National Code Documents.

[25] Canadian Commission on Building and Fire Codes. 1995. "Building the Future – The Strategic Plan of the Canadian Commission on Building and Fire Codes 1995-2000." Institute for Research in Construction, National Research Council Canada.

evolutionary approach that would still achieve the benefits of performance-based codes was sought.

The approach that was settled on was to retain the existing mixture of performance and prescriptive code provisions but to tie each provision to at least one explicitly stated Code objective. The objectives of the Codes had never been explicitly stated, although they were alluded to in the prefaces.

Thus, in order for this objective-based approach to work, it was necessary to define these objectives quite precisely and to fully engage the provinces and territories throughout the process.

Top-Down and Bottom-Up Analysis

It was decided to conduct both top-down and bottom-up analysis of the Codes –

- A Task Group on Implementation of Objective-Based Codes would consider from first principles which objectives each Code should and should not address. This task group was a joint effort of the CCBFC and the provinces and territories.
- The standing committees[26] with technical responsibility for the various parts of the Codes would analyze each provision to identify what overall objective(s) they seemed to be addressing and determine their intents and application.

The objectives that were eventually declared to be the objectives of the National Code Documents were derived from a synthesis of the bottom-up analysis of all the provisions of the three 1995 National Code Documents—some 6000 sentences in all. After nearly 10 years of development of the concept the 2005 National Code Documents were published in an objective-based format in September 2005.

OBJECTIVE-BASED CODES CONCEPT

The fundamental concept behind the 2005 objective-based codes in Canada is the recognition that the acceptable solutions represent an implicit expression of the levels of building performance that are acceptable to society. Objective-based codes are articulated around acceptable solutions, which play two important roles:

1. In objective-based codes, acceptable solutions are maintained and represent one of the two compliance options. Following the technical specifications of the acceptable solutions is deemed to meet the objectives and performance expectations of the Codes. Acceptable solutions consist of provisions—either prescriptive or performance-based—that have been developed over time under the code development system in place before the introduction of objective-based codes. Acceptable solutions will continue to be developed and updated under objective-based codes and will continue to offer to Code users a straightforward way of complying with the Codes.

[26] Although the CCBFC makes final decisions regarding the content of the National Code Documents, it is assisted by standing committees responsible for the development and updating of all technical aspects of the codes. Like the CCBFC, standing committees consist of volunteers from all segments of the construction community but have more specific technical expertise based on their respective areas of responsibility.

2. The second compliance option under objective-based codes is through the use of alternative solutions, i.e. innovative solutions that differ from the specifications of the acceptable solutions. To be acceptable, an alternative solution must provide a level of performance at least equivalent to that of the acceptable solution(s) it is replacing. When evaluating innovative solutions for compliance, the areas of performance to be examined are clearly identified by the objectives, functional statements and intents attributed to each specification of the acceptable solutions. Innovative solutions are not limited to "prescriptive" solutions. Both prescriptive and performance design options are permitted but their common denominator is that an alternative solution must provide a level of performance at least equivalent to the acceptable solutions it replaces.

TRANSITION TO OBJECTIVE-BASED CODES

Adoption of Objective-Based Codes

In Canada, building and fire regulation is the authority of the provinces and territories – 13 jurisdictions in total - and they adopt or use the model National Code Documents as the basis for their regulations. Some jurisdictions adopt the latest edition of the national codes shortly after publication while others may take up to two or three years. The 2005 "objective-based" National Code Documents were published in September 2005. As all provinces and territories have participated in the development of the objective-based concept it was anticipated that they would gradually adopt this concept in their regulations. In 2008 more than 95% of Canadian population lives in a jurisdiction where building and fire regulations are based on the 2005 "objective-based" model National Code Documents.

Training for Objective-Based Codes

In Canada, training on Codes is normally the domain of the provinces and territories and the CCBFC plays no role. However, it was realized that all jurisdictions would have common training needs related to the introduction of objective-based codes, so it was agreed that the transition training materials should be developed jointly under the aegis of a new committee under the CCBFC called the National Steering Committee on Training and Education for Objective-Based Codes. This training material was completed in 2005 and introduces the new structure of the Codes and the new terminology, and provides guidance on dealing with alternative solutions. As provinces and territories adopt new building regulations based on the 2005 objective-based codes they set up training programs within their jurisdictions.

Decision-Making with Objective-Based Codes

Well before the objective-based concept the model national codes have had a long tradition of allowing alternatives to the prescriptions of the codes provided it could be demonstrated that they provide "equivalent" performance. The introduction of objective-based codes in 2005 has not changed this practice but has brought clarity to the intent and objectives of the codes as well as the level of performance expected from alternative solutions.

All actors of the regulatory system are familiar with and experienced using this "equivalency" approach. In many instances the building regulatory authorities would require a third party conformity assessment to demonstrate equivalent performance of an alternative solution.

As an example at NRC, the Canadian Construction Materials Centre (CCMC) was established in 1988 to help manufacturers demonstrate conformity of their new innovative construction products and systems to the codes (http://irc.nrc-cnrc.gc.ca/ccmc). CCMC evaluation reports provide an impartial opinion that is used by regulatory authorities in making decision on the acceptability and code compliance of new products and systems that are not addressed in the codes.

FUTURE OF OBJECTIVE-BASED CODES

Objectives

In an objective-based code, every acceptable solution is linked to at least one of the Codes' objectives and functional statements**.** Therefore, a proposal to add an acceptable solution that cannot be linked to one of the established objectives would require the creation of a new objective. While these objectives are not necessarily fixed for all time, the CCBFC will only add an objective after very careful consideration, and extensive consultation with the Code community and its major stakeholders.

Level of Performance

New acceptable solutions beyond those in the current Codes will be added over time through the regular updating process. A reduction or increase in the acceptable level of performance over time is possible under objective-based codes and can be achieved by the introduction or revision of acceptable solutions against which alternatives will be evaluated.

PERFORMANCE-BASED CODES

Some stakeholders may perceive objective-based codes as a transitional approach towards the introduction of fully performance-based building regulations. This is not necessarily the case since some parts of the Codes might logically be left in prescriptive format and some parts of the code-using community might prefer it that way. Nevertheless, there is a general trend towards performance-based codes and objective-based codes can help guide the way along that path.

The implicit level of performance embedded in the acceptable solutions can be viewed as representing society's expectations of building performance. Converting this implicit level of performance into quantitative terms is a critical first step in the development of measurable and verifiable performance criteria that closely reflect society's expectations—the performance criteria that are essential to true performance-based codes. This is an area where research is needed to develop tools and methods that allow the quantification of the implicit level of performance of acceptable solutions. As more knowledge becomes available, more areas of the Codes may be developed into a performance path with quantitative, measurable and verifiable performance criteria, including their verification methods.

ABOUT THE NATIONAL RESEARCH COUNCIL, INSTITUTE FOR RESEARCH IN CONSTRUCTION (NRC-IRC)

The NRC Institute for Research in Construction (NRC-IRC) is the leading construction research agency in Canada. Equipped with world-class facilities, NRC-IRC carries out applied and contract research on issues of strategic importance to the Canadian construction sector. Through an integrated, multidisciplinary approach, NRC-IRC assists the sector to become more competitive through innovation and to foster the provision of safe and sustainable built environments.

Core Research Programs

Building Envelope and Structure: technologies for the design, construction, and operation of durable, energy-efficient, and cost-effective building systems. These technologies address both new construction and repair or renovation, for all types of buildings and some concrete building structures. Expanding from a traditional emphasis on systems for cold climates, the program now encompasses technology development for conditions in key export markets.

Fire Research: technologies for advancing the fire safety design and operation of buildings and transportation systems, enhancing fire detection and suppression systems, and reducing the risks and costs of fire. Experiments, computer modelling and consideration of human factors all figure in the research.

Indoor Environment: cost-effective and energy-efficient technologies and tools for the design and operation of indoor environments that optimize the comfort, satisfaction and health of building occupants. The research addresses acoustics, lighting, thermal comfort, and ventilation and air quality.

Urban Infrastructure: technologies for the design and rehabilitation of infrastructure systems, and innovative tools and techniques for the evaluation and management of these systems. The research focuses on buried utilities and concrete structures (Ottawa) and sustainable infrastructure for water and wastewater systems (Regina).

Codes and Evaluation

NRC-IRC further contributes to safety and efficiency in construction through its code support and product evaluation service. The Canadian Codes Centre supports the development of the National Building Code and other national codes on which construction regulation across Canada is based. The Canadian Construction Materials Centre evaluation reports provide opinions on the suitability of innovative products in accordance with code requirements.

Technology Transfer

NRC-IRC delivers results and solutions to the construction sector through its research contracts, consortium projects, license agreements, its newsletter Construction Innovation, technical publications such as Construction Technology Updates, national seminars , and many other means.

HOW TO CONTACT THE NRC-IRC

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National Research Council Canada | Conseil national de recherches Canada

3.4 TRANSFORMATION OF THE SYSTEM – CHINA

HISTORY

Enacted by the National People's Congress, the supreme law-making body of China, the Construction Law 1997 is the principal building control legislation in China. The State Council formulates administrative regulations in accordance with the Constitution and the Construction Law 1997. The Ministry of Housing and Urban-Rural Development (MOHURD), formerly named the Ministry of Construction (MOC), formulates the department rules under and pursuant to the Construction Law 1997 and the State Council's administrative regulations, decisions and decrees. The MOHURD is responsible for the development and enforcement of the building standards. Building standards can be compulsory or voluntary, as stipulated in the Standardization Law 1988. All of the compulsory requirements in the building standards comprise the technical building regulations in China. Most of the requirements in building standards are currently prescriptive.

Before 2000, the building standards consisted of approximately 3200 compulsory and voluntary standards, of which about 2700, or 85% of the total, were compulsory. The difficulty in complying with so many compulsory standards was recognized, and in 2000, through Minister's Order No. 81, some specific provisions of the compulsory standards were kept mandatory, with the rest of the standards being made voluntary. As appropriate, MOHURD can issue new or revised standards, within which some compulsory provisions may be included, along with associated announcement of the standards being issued. In recent years, there has been a trend towards performance requirements within the compulsory standards.

The building standards system has been further advanced with the emergence of 'full mandatory standards.' The first full mandatory building standard was the *Residential Building Code*, which was introduced in 2005. In keeping with the trend towards performance, the *Residential Building Code* is rather performance-based, although it still contains some prescriptive requirements in order to maintain continuity with the balance of the standards system.

In addition to the *Residential Building Code*, there are also several other full mandatory standards currently at different stages of development. At present, it seems that the full mandatory performance-based standards and the compulsory provisions, including both performance-based and prescriptive requirements, may comprise the technical building regulations, and the non-compulsory provisions may comprise guides to meeting the performance requirements.

As a whole, the introduction of the performance-based approach into Chinese building standards is at the beginning stage, with much more required to transform the prescriptive system to a performance-based system. To date, the principles of performance-based regulations have been taken into account as far as possible when drafting the building standards. Nevertheless, the prescriptive requirements will coexist with the performance-based requirements in the building standards for a period of time, which is necessary and practical in order to keep some continuity in the application of building standards.

ABOUT THE CHINA ACADEMY OF BUILDING RESEARCH (CABR)

Founded in 1953, the China Academy of Building Research (CABR) is the largest and most diverse research institution in the building industry in China. At one time affiliated with the Ministry of Construction (MOC), it transferred from a public institution into a technology-based enterprise on 1 October 2000, affiliated since then with the State-owned Assets Supervision and Administration Commission of the State Council (SASAC).

As the largest comprehensive research and development institute in the building industry in China, CABR carries out its mission in catering to the needs of building and construction industries nationwide, putting forward solutions for the key technical problems met in engineering based on applied research and development, providing technical development and consulting services, and undertaking building design and construction activities. It carries out common, basic and public technical researches required in this industry. With the designation by the MOHURD, CABR is responsible for the development and management of the major building standards and codes of China. It exercises quality supervisions and tests on engineering construction, air conditioning equipment, solar water heater, elevator and chemical building materials so as to promote the scientific advancement of the construction industry, to push forward the standardization of engineering construction, to enhance construction quality management, and to make active contributions to the development of the construction industry in China.

BUILDING STANDARDS AND CODES

CABR is the chief developer of standards and codes relating to design, construction, production, installation, quality testing and acceptance check, safety and management of building structure, foundation, earthquake resistance, building environment and energy efficiency, and material application, covering most fields of the construction engineering. CABR has also developed the standards and codes relating building materials, structural elements, instruments, equipment, building and urban construction machinery, vehicles and elevators. CABR is also responsible for the centralized management of the standards and

codes relating to building physics, air conditioning cleaning, engineering materials, building structures, earthquake engineering, foundation, construction and quality control, testing instruments, heating, ventilation, air conditioning, building and urban construction machinery, construction equipment, vehicles and elevators.

RESEARCH AND EDUCATION

CABR has 14 research institutes (centers) and 77 laboratories, covering 70 research fields of building structure, foundation, earthquake engineering, built environment and energy efficiency, residential building system and product, intelligent building, building engineering software, construction mechanization, building fire prevention, construction technology, and building materials. In recent years, CABR has put more effort into research and development of green building technologies, application technology of new energy, disaster prevention and mitigation technologies, and intelligent integration technology.

With the combination of academicians from the China Academy of Engineering and China Academy of Science, along with national engineering design masters (experts who have made great contributions to the country), as well as many other talents majoring in research, engineering and management, CABR provides a unique learning environment. As one of the authorized units to confer Ph D. degrees throughout the country, CABR is able to confer Ph D. degrees in 3 specialties and Master's degrees in 4 specialties.

THE FUTURE

After the transformation into a technology-based enterprise, CABR, being market-oriented, has established 12 wholly-owned or holding companies, forming an integrated diversified development framework covering research and development, technical services, comprehensive design, planning, survey, quality inspection of construction engineering and product, R&D and production of high and new technologies and products, and engineering contracting as well. CABR takes advantage of industry-leading expertise and capability and focuses on the constant innovation in technologies, products and services for the construction industry. As a result of its efforts, CABR is growing in prominence and influence, and is aiming at becoming a large technology-based enterprise group, advanced in China and well-known in the world, with the mission of building a better future.

HOW TO CONTACT THE CABR

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中国建筑科学研究院
China Academy of Building Research

3.5 TRANSFORMATION OF THE SYSTEM – JAPAN

HISTORY

Japan lies to the west of the circum-Pacific earthquake belt and experiences a high degree of seismic activity. Japan also experiences typhoons, and given the many dense urban environments, conflagrations can occur, particularly in the older urban areas, which are characterized by densely-packed wooden buildings. Given these geographical and social factors, it should be no surprise that Japanese building regulations have developed over many years from a focus on enhancing the disaster-resistance of buildings. To supplement experience gained over many centuries, ongoing building regulation development uses knowledge obtained from leading edge research and adjusts to meet new challenges associated with global climate change, an aging population, international trade issues, and other emerging issues.

As detailed in Annex B, the current principal legislation of building construction is the Building Standard Law (BSL), which regulates basic building construction items related to the rights and obligations of people. Regulation of requirements and procedures are stipulated in cabinet orders, ministerial orders and ministerial notifications as delegated by the law. All of these are mandatory documents, which function integrally, and will hereafter be referred to as 'the BSL and Regulations'.

The BSL, together with the Kenchikushi Law, was enacted in 1950, just after World War II. At that time, millions of houses needed to be rebuilt, and it had to be done in a new, democratic, market-oriented way. The BSL and Regulations set minimum standards for building construction. Kenchikushi (architects/engineers) were newly qualified to take responsibility to design buildings conforming to those minimum standards and to assume responsibility in assuring that the construction work was executed in accordance with the design. The building confirmation system was also established to have building officials confirm the compliance of the building with the BSL and relevant regulations.

This system supported the post-war recovery and the following rapid growth of the Japanese economy. However, in view of the diversified needs for construction administration and of the demand for administrative and financial reform, a private building confirmation

system was introduced in 1999. The current number of the building confirmation applications is around 750,000 per year, of which the private sector undertakes more than 50%.

INTRODUCTION OF PERFORMANCE BASED CODES

Performance-based codes (PBC) were introduced into the BSL and Regulations in 2000. The major thrust for the change was the Deregulation Promotion Plan approved by the Cabinet in 1995, in which PBC were mentioned as the key concept for rationalizing the building regulatory system.

The major challenge at that time was how to introduce PBC smoothly to the existing regulatory framework. It was impossible to abolish the whole system, which had been practiced for 50 years, and to create a new law that would pursue an ideal structure of PBC. Continuity of the regulatory system was essential to avoid social disturbance.

As a result, PBC was added to existing codes to avoid drastic change. PBC does not apply to all items of the BSL. The existing specification requirements coexist with the new PBC requirements. For the part to which PBC has been introduced, its range of application varies depending on the item. The existing specification requirement remains as sample specifications (DTS provisions).To verify the conformity with the performance requirement of construction methods or building materials that do not comply with any sample specifications, concrete verification methods (testing/calculation methods) were specified for some of the provisions. Further, a ministerial approval system was established and the provisions were incorporated extensively for 'alternative solutions' that the above verification methods cannot be applied.

CURRENT CHALLENGE

In 1995, Japan experienced the Great Hanshin Awaji Earthquake, which claimed more than 6,400 lives, mostly of people living in old buildings of which seismic resistance did not meet the current codes. The national seismic committee predicts that in some regions the probability of being hit by a severe earthquake of this scale in the next 30 years is more than 50%. Then a scandal occurred that shook peoples' confidence, not only in old buildings, but in comparatively new buildings.

The falsification of structural data (*Aneha* scandal) uncovered in 2005, was caused by a subcontracted Kenchikushi who falsified the output of structural calculations to cover up his faulty design. No one had discovered the falsifications for ten years, including the original contracting Kenchikushi, builders, building officials or private building inspectors. By the time his misconduct was revealed in November 2005, about one hundred buildings - many of them high-rise condominiums and hotels - had been constructed based on his inadequate designs. Most of them had to be renovated, and some had to be demolished for fear of eventual collapse.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) conducted wide-ranging investigations around the country and found out that some other Kenchikushi had engaged

in similar, albeit minor misconduct, or inappropriate structural calculations. The scandal and the following findings from the investigation show:

- Even in the Japanese building codes, which include prescriptive verification methods and a centralized evaluation system, and which leave relatively little to the users' discretion, there are occasionally misunderstandings and arbitrary interpretations by Kenchikushi, building officials and private building inspectors;
- Rapid progress in building technologies brought about difficulties for building practitioners to catch up with. Computing helps to lower the threshold, but also creates the risk of putting an important part of the design process into a black-box; and
- Professional ethics could be jeopardized under the pressure of market forces. The existing system was not designed to prevent criminal intentions.

The MLIT has been conducting a large scale reformation of the building control system. The purpose of the reform is to restore public trust in the structural safety of buildings by preventing a reoccurrence of 'structural data falsification' and by reinforcing compliance with building regulations.

For that purpose, structural safety provisions in the BSL and Regulations were revised and the building confirmation system was restructured to include the establishment of the structural calculation review system. Also, qualifications, the auditing system and penalty clauses for building practitioners were strengthened. These amendments have been implemented in stages. A new insurance/deposit system, which covers the liability of housing sellers, will be introduced on October 1, 2009.

Maintenance of building equipment is also a major issue. Accidents happened with building equipment, including elevators (lifts), escalators, amusement rides and roller coasters, which might have been prevented if the equipment had been properly maintained. The MLIT is reviewing the periodic reporting system, which is prescribed in the BSL and Regulations.

ABOUT THE MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

The mission of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is to utilize, develop and conserve land in Japan in an integrated and systematic way; develop infrastructure necessary for attaining those goals; implement transportation policies; promote the progress of meteorological tasks; and maintain marine safety and security. The housing bureau of the MLIT is in charge of housing administration as well as building administration including the BSL and Regulations.

http://www.mlit.go.jp/index_e.html

MLIT
Ministry of Land, Infrastructure, Transport and Tourism

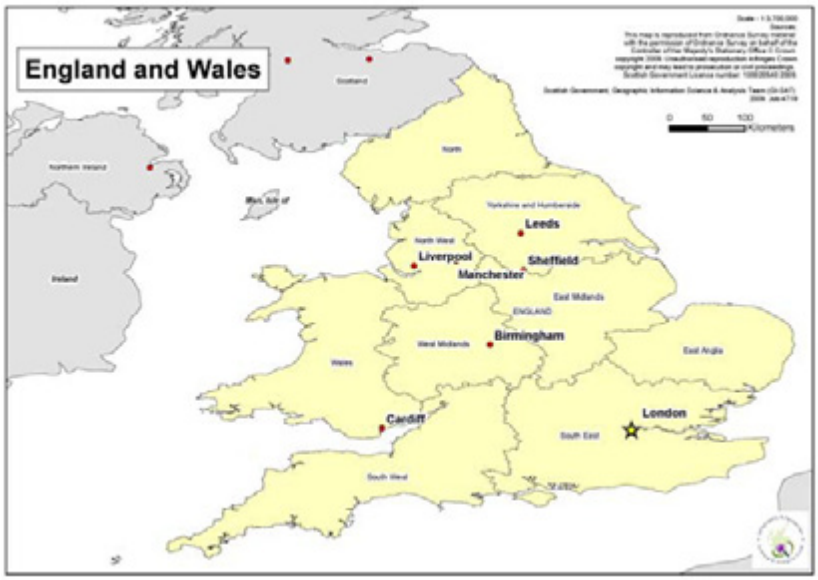
The National Institute for Land and Infrastructure Management (NILIM) belongs to MLIT and its mission is to provide technical assistance to it. Much of the work related to technical aspects of the BSL and Regulations is conducted with the strong support from NILIM. NILIM's activity in this field covers wide-ranging research and development necessary for the enforcement of building regulations and betterment of its system, and development of draft technical standards including technical orders issued under BSL, guidelines and other supplementary documents.

http://www.nilim.go.jp/english/eindex.htm

National Institute for Land
and Infrastructure Management

3.6 TRANSFORMATION OF THE SYSTEM – ENGLAND

HISTORY[27]



The history of building regulations in England and Wales can be traced at least as far back as the Great Fire of London in 1666, after which rules were included in London to prevent wooden buildings being built too close together, so that fire would not jump from one building to another. During the nineteenth century and the reign of Queen Victoria, and into the twentieth century Public Health Acts placed increasing emphasis on improving health and reducing disease, and certain requirements for drainage were introduced. These gradually expanded into other aspects of health and safety, but not on a national basis - each local authority or municipality had its own "Building By-Laws". It was not until the mid-1960s that national Building Regulations were introduced in England and Wales, originally prescriptive rules drawing together the best bits from the various municipal by-laws. In the late 1970s and early 1980s people were becoming increasingly concerned that these prescriptive rules were unsuited to modern society. Legislation was brought before Parliament in 1983 to change to a performance based system, and in 1985 most of the prescriptive rules were abolished and the new system implemented. However, the mandatory rules for means of escape were retained until 1991, to allow greater time for the education and training of both building control officers and fire brigade personnel. The full system of performance based regulations has been in force in England and Wales since 1991.

Impetus for Change[4]

In the late 1970s and early 1980s, building control was solely enforced by officers in local authorities (now there is competition from the private sector) and in many authorities these people had the reputation of looking for any breach in the Regulations, however minor, to stop development going ahead. It was a bureaucratic system much resented by architects and developers. In addition, it was becoming impossible to build some types of buildings to comply with the regulations. For example, in large shopping centers it was impossible to

[27] Unless otherwise noted, this text is excerpted from Everall, P., "Performance-Based Building Legislation: The UK Experience," published in the Proceedings of the *Global Policy Summit on the Role of Performance-Based Building Regulations in Addressing Societal Expectations, International Policy, and Local Needs: Summit Report*, National Research Council, Washington, DC and IRCC, 2004.

reduce travel distances for means of escape to a place of safety to the statutory maxima. And there were no rules which applied to maintaining fire safety in tall buildings containing atria. The general feeling was that the system was inflexible and added little or no value to the completed project. Account was not taken as to where the major risks might be, and priority was given by at least some building control officers to a minute search for faults rather than working with developers to find a satisfactory solution. All of these factors taken together indicated that change was necessary.

The Functional Approach

The system introduced by the 1983 legislation contained very short goal based regulations ("reasonable provision shall be made for means of escape to a place of safety...."). The complete regulations now only take up some nine pages. The regulations are backed up by documents providing guidance on how to comply with each Part of the Regulations. These documents carry statutory weight in that following the guidance in the documents will be taken by the courts to mean that there is compliance with the Regulations. These documents have to be endorsed by a Government Minister before they are published, and hence are known as Approved Documents (ADs). However, designers and developers do not have to follow this guidance. If they wish to use an alternative solution the onus is on them to convince the building control officers that what they propose has health, safety, welfare, convenience and energy efficiency standards at least as good as the guidance in the ADs, and so alternative solutions are encouraged. Indeed, some of the ADs provide more than one solution. For example, in the AD on energy conservation, three methods of compliance are detailed: an elemental approach looking at the energy efficiency of each component (wall, floor, ceiling, window etc) separately; a whole building assessment, which gives a developer the opportunity of trading off one element against another; and a carbon index method.

Benefits of the Functional Based system

The new system is seen to be flexible, and allows the approval of complex buildings through the normal building control process, rather than having to set up administrative arrangements to waive certain of the prescriptive rules. Innovative solutions to buildings are encouraged, and there has been both a proliferation of imaginative designs and the introduction of modern methods of construction, involving much more of the building being constructed within factories rather than on building sites with unfavorable weather and environmental conditions. Also, as noted above, some of the problems with the old system related in particular to finding effective fire solutions. The development of fire safety engineering has led to such solutions being found: solutions which can be readily assessed within the functional-based system. Finally, there is increasing emphasis in all sorts of safety regulations in the UK for these to relate to the degree of personal risk experienced. Again, functional or performance-based regulations enable the degree of risk to be specified. They also allow an assessment of the building as a whole to be made, rather than concentrating on individual elements.

THE TRANSITION PROCESS

It was not possible for an overnight transformation from following the old prescriptive rules to instant acceptance by all the interested parties of the new system. A great deal of education and training was necessary for architects, builders and building control officers. Once initial fears were overcome, architects have generally welcomed the new system as being more flexible in accommodating their innovative designs. Their principal concerns now relate to the increasing complexity of the regulations and the guidance in the ADs, and about the number of times the Regulations are subject to change - a consequence of increasing consumer demands, recognized by Government Ministers for healthy and safe buildings. Builders, on the other hand, have perhaps taken longer to adjust to the new system. Many, particularly those who were small or medium enterprises, quite liked the certainty given by the old prescriptive rules, even if they sometimes rebelled against over-dictatorial building control officers. Many building control officers were resistant to changing from the way they had always carried out their role, and indeed had been trained to do so. Over time, however, they welcome the new system, finding it far more satisfying to exercise judgment than merely following a tick-box approach - even if at the same time it is considerably more challenging. In the end, a key factor was a change in culture, so that building control officers saw their role as helping developers meet the requirements of the regulations to ensure a satisfactory building rather than finding ways of stopping them. It took a good ten years before pockets of resistance in some local authorities were broken down, although the introduction of competition from the private sector at the same time as the new building control system undoubtedly helped the process along.

ABOUT THE DEPARTMENT OF COMMUNITIES AND LOCAL GOVERNMENT (DCLG)

Communities and Local Government aim to create thriving, sustainable, vibrant communities that improve the quality of life. The Department sets policy on local government, housing, urban regeneration, planning and fire and rescue. The Department has responsibility for all race equality and community cohesion related issues in England and for building regulations, fire safety and some housing issues in England.

HOW TO CONTACT THE DCLG

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http://www.communities.gov.uk/planningandbuilding/buildingregulations/

3.7 TRANSFORMATION OF THE SYSTEM – THE NETHERLANDS

HISTORY

The importance of innovation for economic growth and prosperity was accepted by the Dutch government in the early 1980s. The first initiative dealt with a better use of research and development to the innovative needs of the building sector. One of the results was the specification of the relationship between functional concepts, performance requirements, verification methods and technical solutions. The second initiative dealt with the reformulation of the existing municipal technical building regulations on a National level.

An action plan dealing with the conditions and modeling to be used was published in 1983. The basic philosophy that was developed was published by The Ministry of Housing, Physical Planning and Environment (VROM). This basic philosophy was presented in Brussels, Belgium, and accepted in 1985 as the 'New Approach" at the European level. It was one of the structuring elements for the Construction Product Directive (CPD) published by the European Commission in 1998.

After a decade of research, formulation of codes and drafting texts, the Building Degree came into force in 1992. It is based upon the new Housing Act of 1991. The basic philosophy applied is based on the following principles:

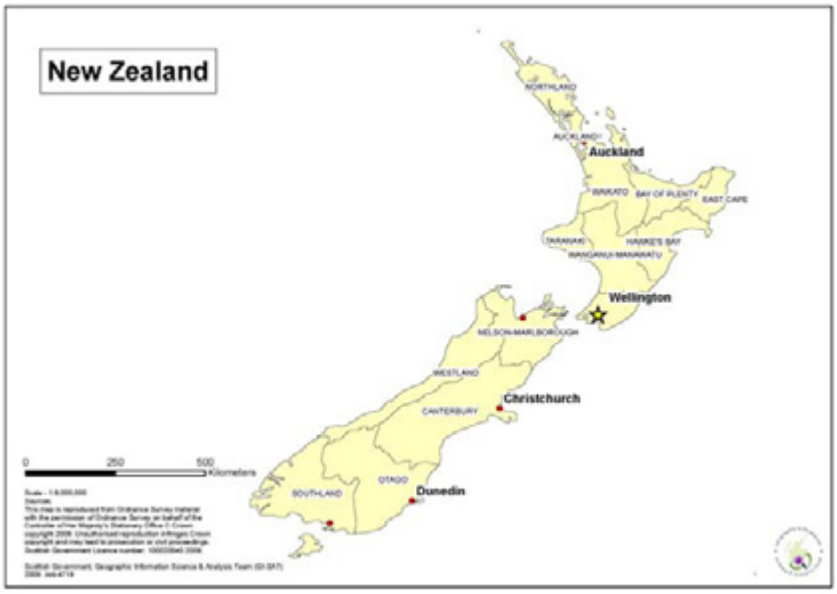
- Performance based approach: all technical issues are regulated into functional and subsequent performance requirements;
- Objective approach: regulations on the levels of work, space, dividing constructions, constructional elements and materials;
- Principle of flexible plans: the possibility to obtain permits without detailed final subdivision of plans, thereby securing equal performance in reality;
- Principles of equal rights: additional construction should not be influenced by the (lower) quality of existing construction;
- Principle of equivalent performance: for innovative solutions it should be possible to prove its performances by scientific means;
- Principle of acquired historical rights: higher levels of performances than those valid according to the original permit, cannot be easily enforced; and

- Reference to private determination methods issued as standards by the National Standardization Institute

Three years after the introduction the Housing Act and Building Degree were evaluated and the main conclusion was that although the new building regulations had a well thought out basis, they were not yet optimal. During the same period the building regulations became an issue of attention in a project carried out by the Ministry of Economic Affairs into Market working, deregulation and the quality of regulation. These evaluations are the reason for a revision of the Dutch building regulations. The aim was to create regulations that are both better connected to the needs and wishes of the Dutch society and that can be better handled and maintained in practice. Based on these findings the Housing Act and Building were re-organized and came into force in 2003.

3.8 TRANSFORMATION OF THE SYSTEM – NEW ZEALAND

HISTORY



The first building legislation in New Zealand was called the Raupo House Ordinance 1842 which levied £20 for building new buildings. This was replaced by the Municipal Corporations Act 1867 which adopted the British system of local authority bylaws. Municipal authorities had wide powers to make local building bylaws. A destructive earthquake in 1931 led to the formation of Standards New Zealand, which published a model building bylaw in 1935. That bylaw, together with numerous Standards incorporated by reference, amounted to a prescriptive Code.

By 1964 model bylaws had been adopted by almost all municipal authorities. The model bylaw at the time was called NZS1900 and was a form of the modern Code. NZS1900 dealt with issues such as fire safety, sanitation, earthquake resistance and other aspects covered by our modern Code. Over the same period, the national government introduced numerous Acts and regulations that applied nationally to particular types of buildings (from crematoria to shearers' accommodation), and to particular aspects of building (including electric wiring, plumbing, and minimum room sizes). Some of that legislation was enforced by the national government and some by municipal authorities. Central government was not bound by bylaws made by municipal authorities. By 1979 building controls were administered under more than 60 Acts by more than 19 national government departments, over 300 municipal authorities and others, such as The New Zealand Fire Service.

By 1986, following widespread industry dissatisfaction that the bureaucracy, the compliance practices, and the complexity of the Acts and bylaws were stifling progress, the national government established a Building Industry Commission. The Commission was established to determine appropriate legal and regulatory provisions for building construction and maintenance of buildings throughout New Zealand. The commission produced a report in 1990 called "Reform of Building Controls". That report mainly recommended establishing a national system under a single Act with subsidiary regulations, to include a performance-based national Code in accordance with the Nordic model.

THE BUILDING ACT 1991 AND THE BUILDING CODE

The national parliament passed the Building Act 1991 and New Zealand, for the first time, had a national building law, which also bound the national government (meaning that government buildings were now subject to the Act and Building Code requirements). In 1992 the Building Regulations were introduced by the national government containing the performance-based Building Code. The purpose of the Building Act 1991 and its Regulations was to provide a consistent approach to building control across the country, and also enable flexibility in the means of Code compliance. This performance-based Building Code, was amongst the first of its kind in the world.

People could choose to comply with the Building Code through an approved document (now called a compliance document), which is prescriptive and is "deemed to comply" with the Code, or through any other means (commonly known as an "alternative solution").

The Building Act 1991 established the Building Industry Authority (BIA) as the national government monitoring agency of the Building Act 1991. Municipal authorities carried out building control functions under the Building Act 1991 and private building certifiers could carry out building consent approval and inspection functions. The Building Act 1991 introduced a range of new provisions:

- Duties and functions of the parties were defined;
- An appeal process (determinations) for aggrieved parties was established, whereby the decisions reached in each case heard were binding on owners, municipal authorities, and national government departments;
- Project Information Memoranda (PIMs) would now be issued by municipal authorities providing information relating to a building project;
- A Building Warrant of Fitness regime was instituted. The system requires ongoing inspection and maintenance of certain life safety systems (specified systems) such as lifts, sprinklers and emergency warning devices; and
- The Building Industry Authority was tasked with monitoring the performance of municipal authorities and private building certifiers' performance and with monitoring and maintaining the Code.

Transition to performance based regulations

There were a number of provisions put in place to allow for a smooth transition between municipal bylaws and the national regulation approach. Educational seminars and meetings took place to explain the introduction of the Building Act 1991 to all involved in the building industry.

The Building Act 1991 provided for a "transition period" of six months during which a building owner could choose whether to apply for a building permit under the municipal bylaws or for a building consent under the Building Act 1991. Few owners chose to proceed under the Building Act 1991 until the transition period had expired and they had no choice. The Building Act 1991 was intended to facilitate innovation, and to introduce a light-handed control system. The Building Act 1991 did not immediately change the way buildings were designed and constructed. That was because almost all the approved documents were the

previous bylaws or the referenced Standards and electrical codes of practice, with few if any substantive amendments.

People took some time to get used to new procedures. It took some years before the use of innovative solutions ("alternative solutions") became more prevalent. Most municipal authorities then had difficulties deciding whether such solutions did in fact comply with the Code. The new process of determinations gradually started to create a "case law" for the Code and in particular for the treatment of alternative solutions. However, very few alternative solutions were reviewed in this manner.

OUTCOME OF PERFORMANCE BASED REGULATIONS

Introducing performance-based building regulation in New Zealand has had mixed outcomes. With a national Building Code, there was improved consistency across the country in consenting building work. It also led to a wider range of designs and materials being used. Sometimes these were good innovations leading to more cost effective solutions. Unfortunately, sometimes inadequate design rigor, the evidence basis used, the building methods applied and the lack of effective supervision resulted in buildings not being Code compliant. Additional controls have been introduced though a new Building Act 2004, including practitioner licensing, accreditation of consent authorities and warrantee provisions. A review of the Building Code was also required. While the failures are acknowledged, there has been no suggestion or demand for the reversion to a prescriptive code.

Other factors contributed to this less than successful outcome for the introduction of performance based regulation in New Zealand. The Code's outcome requirements are often qualitative and lacking in specificity to allow alternative solutions to be easily developed. The qualitative nature of the requirements leads to heavy reliance on expert interpretation. This has often been obtained through 'producer statements'. Producer statements were statements under the Building Act 1991 that could be accepted by municipal authorities as verification that the work specified in the statement would be or had been carried out in accordance with the Code. Reliance on producer statements led to alternative solutions not receiving the scrutiny by municipal authorities that was needed to ensure Code compliance.

A particular series of alternative solutions resulted in widespread failures of timber framed buildings, particularly houses and apartment blocks with face-fixed claddings. When such claddings proved not to be weather-tight, untreated framing timbers intended for use in dry situations became wet and rotted. Poor workmanship and cost-cutting building practices also contributed to what became known as "the leaky building crisis".

Alternative solutions in fire engineering also became a concern, with few municipal authorities having specialist expertise in that field to decide if designs were Code compliant.

There is clear evidence that some of the issues have been caused by a lack of coordination between the various parties involved in the design and construction process. This is being addressed in the practitioner licensing regime. However, the way the Building Code Compliance Documents are structured does not help industry integration. Compliance

Documents provide solutions by building function, e.g. structure, fire and ventilation, rather than a 'whole of building' approach. This does not help in understanding that buildings are complex systems and that many of their functions are interrelated.

RESPONSE TO PERFORMANCE BASED REGULATION ISSUES

The Building Act 1991 was replaced by the Building Act 2004 as a direct result of the leaky building crisis. Features of the Building Act 2004 include:

- The establishment of the Department of Building and Housing to replace the Building Industry Authority as the central regulator, placing direct accountabilities on Ministers;
- Building work compliance and the issuing of the final Code Compliance Certificate is based on a building consent as opposed to the Code. This is to encourage a greater focus on design and review prior to project commencement;
- Municipal authorities must become registered by 31 March 2009 as building consent authorities by demonstrating that they have appropriate procedures and facilities operated by qualified staff. Private organizations may also apply for registration;
- After November 2010 certain building work must be done or supervised by licensed building practitioners who have demonstrated their skill and competence;
- Alternative fire engineering solutions for major buildings must be submitted to the New Zealand Fire Service for advice; and
- There is no mention of producer statements.

The Building Act 2004 did not alter the Code, but the Department of Building and Housing was required to review the Code and consider whether it met the requirements of the Building Act 2004 and was stated in sufficient detail to provide clear guidance on performance standards.

Compliance documents are also changing in response to the issues introduced by performance based regulations, e.g.:

- The compliance document dealing with external moisture now contains provisions for integration between elements of building envelope, other Code requirements such as structure and connecting materials, and external influences such as site characteristics and orientation; and
- A broader review of compliance documents currently underway may result in compliance documents based on the 'whole-of-building' approach, for example, a compliance document for single detached residential dwellings.

The issues that have been faced by implementing a performance-based Building Code have highlighted the need to consider the whole building regulatory system, including:

- Competence of the sector (designers, builders and building officials). A performance-based regime requires complex technical decisions to be made, particularly at the time the building consent approval is being considered;
- Education. In spite of education seminars undertaken at the time the performance-based system was introduced, it is clear that even after 17 years, there are many in the sector who do not understand how it operates;

- Liability regime. The 'joint and several' liability regime that operates in New Zealand has resulted in municipal authorities often having to pay high costs for remediation. This has resulted in 'risk averse' behaviour by some when consenting new building work and has often resulted in difficulties in getting 'alternative solutions' approved; and
- Complexity and accessibility of technical requirements. Many requirements are included in Standards documents that are referenced in compliance documents. This can create a web of inter-related documents that are not always consistent.

These issues are all currently being considered by the Department in order to simplify the system and improve understanding, adherence and efficiency.

ABOUT THE DEPARTMENT OF BUILDING AND HOUSING (DBH)

The Department of Building and Housing was established in November 2004. It brings together in one organization building and housing sector policy and related regulatory functions and dispute resolution services which were previously delivered across a range of government agencies. Consolidating the Government's building- and housing-related activities is designed to:

- Ensure an effective regulatory system for the building and housing sector;
- Deliver good-quality advice to the government; and
- Improve and streamline services to the public.

The Department incorporates the former Ministry of Housing, the Building Industry Authority, the Weathertight Homes Resolution Service (formerly in the Department of Internal Affairs), the building policy functions from the Ministry of Economic Development, and related functions from the Ministry of Social Development and Housing New Zealand Corporation. The Department is responsible for:

- Ensuring an effective regulatory environment for the sector;
- Regulating the sector;
- Delivering effective information, advice and dispute resolution services;
- providing purchase and monitoring advice to the government on Housing New Zealand Corporation;
- Providing policy advice on the sector, including emerging trends and issues and regulation;
- Providing occupational licensing for the sector;
- Working with Housing New Zealand Corporation to improve housing outcomes for the sector;
- Undertaking analysis of the building and housing environment, emerging issues and monitoring trends;
- Influencing the wider Government sector to ensure it contributes to the Government's goals for housing;
- Working with other agencies to influence and promote delivering the Government's outcomes for the housing and building sector; and
- Undertaking specific initiatives under the New Zealand Housing Strategy.

The Department vision is that the people of New Zealand have access to quality homes and buildings that meet their needs and reflect our New Zealand environment. The Department does this by taking a 'big picture' approach to the building and housing sector that covers many of the ways New Zealanders interact with their buildings - from design and construction to living and renting. In bringing these elements together, the Department is responsible for:

- Making sure the laws and standards that govern the building and housing sector are effective;
- Providing good information, advice and dispute resolution services;
- Working with the building and housing sector to develop better professional standards, skills and behaviors; and
- Providing policy advice to the government.

Some of the ways the Department is doing this include:

- Leading widespread change through the Building Act 2004 to develop a better-performing building sector;
- Setting standards for New Zealand buildings;
- Reviewing the law in response to changes in renting and apartment living and occupying homes in retirement villages;
- Enhancing service delivery to landlords and tenants;
- Developing a licensing scheme for building practitioners;
- Working towards resolving weathertightness issues; and
- Working with the sector in a leadership role to encourage industry improvement as a preferred means rather than regulating.

HOW TO CONTACT THE DBH

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3.9 TRANSFORMATION OF THE SYSTEM – NORWAY

HISTORY

The Planning and Building Act of 14 June 1985, No. 77, is the basis for building regulation in Norway. The Planning and Building Act makes reference to Technical Regulations, Guidelines and standards and other recognized documents, such as the Norwegian Building Research Institute's series of planning and technical information circulars. There are three levels of documentation of conformity under The Planning and Building Act:

- The Technical Regulations, which since 1997, express the required performance;
- The Guidelines, which give pre-accepted performance levels (i.e., they indicate what level of safety is sufficient to satisfy the performance requirements, and also give guidance to alternative ways to determine acceptable performance for the individual part of the construction); and
- Standards and other acknowledged documentation, which tells how the different construction members have to be designed in order to fulfill the required level of performance. This includes the Norwegian Building Research Institute's series of planning and technical information leaflets, which are commonly understood as acceptable solutions, and in practice constitute the main source of verification.

REASON FOR CHANGE

A 1994 report by the Norwegian Building Research Institute concluded that it is likely that 5% of the total output of the construction industry in Norway was used to remedy building defects. Design, execution and material or product failures all had their fair share in the reasons for building defects, but it should be noted that 60% of the defects had their cause in work done prior to construction. This was good justification for putting more resources into planning and design.

In addition, there was a drive towards simplification of legislation and a reduction in the level and the services of local building control in the mid-1990s. Related or not, we have experienced some serious structural collapses and losses due to fire also added to an

unsatisfactory record. From the point of view of the building authorities, reasons for concern were to be found in:

- Insufficient knowledge of the Building Act and Building Regulations in the building industry;
- Incomplete, insufficient or incorrect design as basis for construction works;
- Lack of systematic documentation of conformity with regulatory requirements;
- Public control was primarily concerned with site inspection, not design control; and
- Primarily the client, secondly the contractors but not the designer being accountable to the building authorities.

Since one might think that full compliance with the building code should result in close to zero building defects, the data showed that this was clearly not the case. Altogether, these arguments prompted the decision of the government to amend the Planning and Building Law. Consequently new regulations dealing with accountability towards public authorities, new building control systems and qualifications of companies undertaking design and construction were introduced. The new regulations represented a breach with the previous trend of de-regulation and put the emphasis on quality of buildings. The most important changes included:

- New requirements for documentation in applying for building permit, and verification of compliance with performance based codes;
- A new control system of improved requirements for supervision and control of building works;
- New requirements as to accountability towards local authorities of the parties of the building process and to their qualifications;
- New procedures for the local authority in passing of the plans and their use of penal clauses;
- New division of roles between local authorities and the client;
- A drive to achieve uniformity in the work methods in all local authorities; and
- The qualifications and competence of designers and contractors had to be documented and certified by the building authorities.

IMPLEMENTATION

The new system was tried out on several strategic projects in 1998, the most ambitious one being the new national airport. This airport, opened in October 1999, was the largest land based project ever built in Norway. It is situated some 50 km out of Oslo in a small local authority (15,000 inhabitants) with limited resources. In no way could this local authority deal with passing the plans and building control according to the old regulations. A by-law was therefore passed, making the then proposed new regulations statutory for the project. The control and quality system of the airports authority was integrated in the requirements of the local building authority. Control plans, inspection and reporting procedures were according to the new control system. This proved a success. In spite of a short design and construction period, there was no delay in progress due to the local authorities the building code was adhered to and the quality of the building works so far has proved satisfactory. More emphasis was put on documentation for design control than on execution. Formal

quality revisions by the building authorities were used at regular intervals for selected parts of the works. The success is obviously related to the professionalism of the actors of a project this size and the existence of quality systems. One of the results that emerged was the need for better description and cost control of third party control.

EXPERIENCES

As expected, there was resistance and skepticism to many of the changes, but in addition, there were some unexpected consequences. One such unexpected challenge was the incredible increase in the number of applications for building permit in the last two weeks before the new regulations went into effect. The total load was equivalent to almost one year of normal work load for the local authorities. The requirement for qualifications also presented some issues, since the number of firms applying for central approval was twice what was expected. Also, there was some trepidation, since failure to attain approval would result in other problems. The quality approach was generally accepted, since it is part of doing business. A few other observations were made in the first years, including:

- There was some indication of an increase in the rate of mergers of smaller firms;
- The detailing of control plans is laborious and need adjusting;
- The knowledge of regulations has vastly improved at all levels, and the awareness and importance of improved control and quality has been recognized;
- The time required to obtain building permit showed an initial increase, but has been brought down to an acceptable level;
- Industry does complain about increased bureaucracy, but is all the same generally in favor of the changes; and
- There has been an initial slight increase in the building cost, but there is uncertainty as to what proportion should be attributed to stricter requirements in the technical code, to the procedural rules and to a coinciding building boom.

ABOUT THE NATIONAL OFFICE OF BUILDING TECHNOLOGY AND ADMINISTRATION (NOBTA)

The National Office of Building Technology and Administration serves as a link between the Ministry of Local Government, the building industry and the public. The office provides the authorities with better insight into matters affecting the building industry and encourages cooperation between the industry and the public sector. The office is responsible for administering and interpreting national building regulations, and has the authority to administer a centralized system of Approval of designers, constructors or controllers in the building industry. The office is also responsible for providing guidance and information concerning national building regulations. Furthermore, the office conducts studies to provide a sound basis for revision or simplification of the regulations.

HOW TO CONTACT THE NOBTA

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3.10 TRANSFORMATION OF THE SYSTEM – SCOTLAND

HISTORY

The previous building control system in Scotland was based on the recommendations contained in the report of the Committee on Building Legislation in Scotland, commonly known as the Guest Report published in 1957. This recommended that the Government establish a set of national building standards to protect the public from the health and safety risks posed by unregulated building. These recommendations were accepted, and resulted in the adoption of the Building (Scotland) Act 1959. The first set of Building Regulations was published in 1963 and came into force in 1964. Since 1959 there have been several reviews of the regulations and there was also a new Act in 1970, which made some amendments to the existing Act. Administration of the building control system in Scotland lay with local authorities.

REASONS FOR CHANGE

In 1998 the responsibility for building control in Scotland was devolved to Scottish Ministers under the Scotland Act. The Minister responsible for Building Control recognized that the existing system had worked well for the last forty years, however higher standards were expected of our buildings and greater flexibility was expected of our designers. Less red tape was also being demanded of our public bodies.

In addition to these factors The European Commission's Construction Products Directive (CPD), incorporated into UK law through the Construction Products Regulations 1991 required the replacement of existing EU member states' national technical standards with Europe-wide technical specifications for construction products, the first of which was introduced during 2001.

The CPD was introduced to create an effective single market for construction products across the European Union. The European Commission can consider taking legal action against a state where a manufacturer can show that the state has failed to apply a European standard which has subsequently damaged sales of a product in that state. These rules could have left Scottish Ministers open to possible legal proceedings if the Scottish

technical standards disadvantaged the sale of an approved European construction product. Any financial penalties would be paid from the Scottish Government's budget. It was therefore decided there was a need for change.

The Building (Scotland) Bill was introduced to the Scottish Parliament in 2002 with the aim of introducing more flexibility into the building control system. It was intended that architects would have greater freedom to use innovative designs while allowing the Scottish Government to meet its obligations under the European Construction Products Directive. It also introduced greater powers for local authorities to deal with potentially dangerous buildings and a mechanism for greater reassurance to those using trades people.

THE CURRENT SYSTEM

On 1 May 2005 a new building standards system in Scotland was established by the Building (Scotland) Act 2003. The Act gave powers to the Scottish Ministers to make building regulations, procedure regulations, fees regulations and other supporting legislation as necessary, to fulfill the purposes of the Act. This included setting building standards and dealing with dangerous and defective buildings. The various regulations are made by the Scottish Ministers, but must be approved by the Scottish Parliament before coming into force.

The system is intended to ensure that building work on both new and existing buildings results in buildings that meet reasonable standards to:

- Secure the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings;
- Further the conservation of fuel and power; and
- Further the achievement of sustainable development.

The new system is an evolution of the existing one with much of the control processes largely unchanged following its introduction. The main differences between the existing and current system can be summarized as follows:

- Scottish Ministers continue to set building regulations, which establish minimal functional standards for buildings, by Statutory Instrument. However, technical standards are no longer established by Statutory Instrument and take the form of "guidance";
- Owners are now responsible for showing compliance with building regulations and for applying for building warrants (permits) and completion certificates. The existing system did not require the owner of a building to carry out these tasks, which would normally be carried out by the person carrying out the building work;

- All local authorities now maintain a more extensive publicly accessible building standards register, whose contents include details of all building warrants and completion certificate submissions; and
- From May 2009, the majority of Crown Building have to comply with current building standards.

Under the existing system local authorities were solely responsible for the verification of building standards. The Act gives Scottish Ministers the power to designate private companies, organizations and individuals as verifiers as in England and Wales. However the current Government in Scotland supports local authorities and such a change is unlikely to happen. In any case, enforcement of building law would still be by local authorities even if other verifiers were appointed.

Approved certifiers of design and approved certifiers of construction are new designations introduced by the current system.

THE TRANSITION PROCESS

The old system was very rigid. Nothing could be altered without a change in law, approved by Parliament. The new system has a short legal document, with most of the detail contained in guidance books that can be more quickly updated.

The new system was expanded and improved to permit certain parts of design and construction to be certified by suitable people, removing the need for the verifier to check that part of work. The old system allowed this to happen for structural design, and for electrical installation, but there were weaknesses. The new system applies more strict rules to be met by certifiers, introduces ongoing checks, and makes it possible for certification to happen for other parts of buildings.

These changes are happening slowly. Currently there are four approved certification schemes and six scheme providers. There are two design schemes; one for structural safety and the other for energy. The two certification of construction schemes cover electrical installation and Drainage, Heating and Plumbing respectively.

The intention behind the certification schemes is to get designers and constructors to be more responsible for meeting the building regulations. They need to know the regulations better, because they now change so often, and they need to care about whether the regulations are met, or else practice on site will never be as good as it should be. This is especially important in the Scottish system where the emphasis is on getting a design approved before work starts, not on doing site checks.

The new system also brings new challenges for local authorities. With standards expressed in functional form, and most detail now just guidance, the building standards officers in local authorities must use professional judgment more, not just apply a rule. While many have always done this well, others are finding this more difficult. Building Standards Division has had to adopt new ways of informing local authorities about the system, and these have not been entirely successful. There are also of course with any new system matters that are not clearly enough defined – and work continues on these. Nearly five years on and the system

is beginning to show its potential to be much more flexible, responsive and better suited to modern construction practices.

In May 2007, the first set of major technical changes were introduced to the technical guidance books, including greater accessibility to new homes and buildings as well as substantially improving energy standards to reduce carbon dioxide emissions.

ABOUT THE SCOTTISH GOVERNMENT BUILDING STANDARDS DIVISION

In June 2004 to fulfill the duties placed on the Scottish Ministers by the 2003 Act the Scottish Building Standards Agency (SBSA) was established. In April 2008 as part of the new Scottish Government's public reform agenda SBSA was reintegrated into the core Government as part of a new Directorate for the Built Environment, which combines, architecture policy, building standards and planning. This organizational framework was to ensure a more integrated approach to the built environment. The Building Standards Division (BSD) now undertakes the work of the former agency including preparing and updating building standards legislation and guidance documents, conducting any necessary research and consulting on changes as the Act requires. The Division, on behalf of the Scottish Ministers, gives views to help verifiers make decisions in particular cases, and deals with applications to relax standards for particular matters. It also approves verifiers, and certifiers of design and construction and it checks how verifiers and certification scheme providers are operating the system. Finally, should it be necessary, the Scottish Ministers can, through the Division, take over the enforcement role of a local authority.

HOW TO CONTACT THE SCOTTISH GOVERNMENT BUILDING STANDARDS DIVISION

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The Scottish Government

3.11 TRANSFORMATION OF THE SYSTEM – SINGAPORE

HISTORY

When Singapore was under the control of the British, the erection of private buildings in the city area was regulated by the City Architect & Building Surveyor under the City Council, whereas the rural areas were under the charge of the Rural Board Building Surveyor. Separate building regulations and by-laws were used by the City Council and the Rural Board at that time. The Public Works Department undertook design of government buildings during the period.

After Self-Government

In 1959 when self-government was attained, the Building Surveyor's sections of the City Council and the Rural Board were merged to form the Chief Building Surveyor's Department, and the department was placed under the Ministry of National Development. In 1966, the Municipal Building By-laws and Rural Board Building By-laws were merged and included into a set of regulations that applied nationwide named the Local Government (Building) Regulations. In February 1972, the Chief Building Surveyor's Department was abolished and a new Building Control Division was created under the Public Works Department. The new Division took over all the functions of the Chief Building Surveyor's Department.

Singapore in 1960s

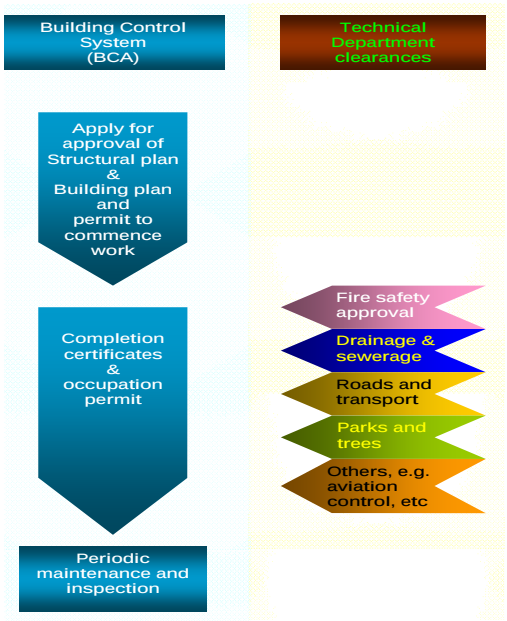
Singapore now

Enactment of the Building Control Act

The Building Control Act (1973) was promulgated on 1 April 1974 and, amongst other things, it repealed the provisions of Part III of the Local Government Integration Act. The Building Control Regulations were promulgated in 1979, with the enactment of three sets of regulations. The Building Control (Administration) Regulations (1979) and the Building Control (Space, Light and Ventilation) Regulations (1979) came into force on 3 August 1979. These were followed shortly by the Building Control (Construction) Regulations (1979), which came into force on 23 November 1979. The Building Control Act and Regulations were repealed and re-enacted in May 1989, to take in recommendations of the Commission of Inquiry into a tragic collapse of a six-storey building called Lian Yak Building on 15 March 1986. The building, which was commonly known as Hotel New World, had stood for 15 years before it collapsed and the incident killed 33 people.

The provisions in the new Building Control Act 1989 were formulated by the Building Control Working Committee which was chaired by the Director-General of Public Works. Key changes included the introduction of the Accredited Checker (AC) system (which is a peer review system to minimize the risk of design errors arising from lapses on the part of the design professional engineer) and mandatory periodic inspection of completed buildings, which is to be carried out by structural engineers to ensure that the structures of buildings are maintained in good condition for continued occupation. A new Building Structural Branch was formed within the Building Control Division of the Public Works Department to administer these new provisions pertaining to structural safety.

On 1 April 1999, the Construction Industry Development Board and Building Control Division of the Public Works Department merged to form a new statutory board known as the Building and Construction Authority (BCA), which took over the administration of the building control system. In administering the building control system, BCA works closely with other technical departments to ensure that other appropriate regulatory measures on safety (such as fire safety, pollution control) and amenities (such as drainage, access roads, parks, etc) have been provided.



Overview of the building control system

Recommendations from the Committee of Inquiry into the Nicoll Highway Incident (where a 30 metres section of deep cut & cover excavation for a mass rapid transit system tunnel collapsed in April 2004) were incorporated into the Building Control Amendment Act of 2007. The key changes incorporated in the 2007 amendments include new provisions to regulate deep underground building works as well as temporary earth-retaining system, to enforce mandatory licensing of general and specialist builders and to require the appointment of supervision teams to supervise structural works.

Transition to Performance-based Approach

Since Jan 2004, a performance-based approach had been introduced into the building control system. The aim is to enable designers to explore alternative design approaches and come up with innovative design solutions that can best meet the objectives of the regulations as well as the needs of their clients. Alternatively, if designers do not wish to take the performance-based approach, they can continue to adopt the prescriptive requirements which are deemed as acceptable solutions satisfying the objectives and performance criteria of the performance-based regulations.

ABOUT THE BUILDING AND CONSTRUCTION AUTHORITY

The Building and Construction Authority (BCA), which was formed on 1 April 1999 through the merger of the Construction Industry Development Board and the Building Control Division of the Public Works Department, is an agency under the Ministry of National Development. Its role is to champion the development of an excellent built environment for Singapore. “Built environment” refers to buildings, structures and infrastructure in Singapore that provide the setting for the community’s activities.

Safety, quality, sustainability and user-friendliness are four key areas where BCA has a very significant influence on the built environment. To administer the various functions pertaining to these 4 key areas, BCA is organized into three core groupings, as follows:

(A) Building Control

This grouping comprises the –

a) Building Engineering Division, which administers the building control system governing structural safety of new buildings
b) Building Plan and Management Division, which administers the building control system governing the architectural and amenities aspects of new buildings, outdoor advertisement licensing as well as management and maintenance of private buildings
c) Special Functions Division, which administers the building control system governing engineering services for civil defence shelters and key installations, periodic structural inspections for existing building and unauthorized construction and coastal protection initiatives to address long term sea level rises due to climate change effects

(B) Industry and Corporate Development

This grouping comprises:

a) Business Development Division, which deals with business matters concerning the construction industry including procurement policies, a contractors registry, export promotion, construction economics and resource planning, management of aggregate terminals and land for supporting industries
b) Manpower & Strategic Policy Division, which deals with manpower matters concerning the construction industry including manpower policies and career promotion, technical, supervisory and management training as well as trade skills training and certification
c) Technology Development Division, which deals with technological matters concerning the construction industry including CONQUAS and Quality Mark programmes, ISO 9000, ISO 14000, OHSAS 18000 certification, Green Mark for Buildings scheme, buildability and productivity promotion as well as good industry practices promotion
d) Corporate Development Division, which deals with BCA's corporate matters including administration, corporate communications, financial management, human resource, information systems and the CORENET e-Submission system implementation

(C) BCA Academy of the Built Environment

This grouping comprises:

a) Training and Professional Development Division, which manages the School of Building and Development, the School of Graduate and Management Development and the Business Development Centre
b) Corporate Services Division, which manages the corporate services of the Academy and the BCA Gallery

c) Research Division, which manages the Centre for Building research

HOW TO CONTACT THE BUILDING AND CONSTRUCTION AUTHORITY

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3.12 TRANSFORMATION OF THE SYSTEM – SPAIN

HISTORY

Until 2006, Spain did not have a single Building Code. Before this time, Spain had always used an "open regulatory framework" to establish the technical requirements for buildings. This 2006 code was necessary, among other reasons, because the system was obsolete, inefficient, diverse and incomplete, apart from having an old prescriptive approach.

In 1999, the Building Act (Ley 38/1999 de Ordenacion de la Edificacion, known as LOE) was passed in the Spanish Parliament, establishing a new building regulatory system. The Act is aimed to achieve a better quality in building, so provisions setting the minimum building quality levels, the professional competencies and the responsibilities of all regulatory stakeholders (designers, contractors, authorities) and the liabilities and insurance requirements were set out in it. So, the Act sets, in terms of objectives, basic building requirements regarding functionality, safety and habitability, which include requirements on accessibility, structural and fire safety, safety in use, hygiene, health and environment protection, protection against noise and energy and thermal insulation. These general objectives provided in the Act have been developed by the Central Government in a Technical Building Code (*Código Técnico de la Edificación* or CTE).

A first draft of this new code was released in 2002 for consultation by the Ministry of Development. A second draft was launched in 2004 when the new Ministry of Housing was created, and finally the code was approved in March 2006. As part of this effort, the old set of seven Basic Building Standards, NBE, in some cases with a very prescriptive approach, was reconverted through the code to a better-defined performance approach.

Once the code was approved, the political challenge was to then supersede the old and obsolete framework with a modern, simple and effective set of building regulations – unified in a single code – comparable to the most advanced in the world and providing for effectiveness and competitiveness in the sector.

In order to simplify its understanding and updating, the new code was arranged in two parts. The first part includes general provisions and a detailed expression (in performance qualitative or quantitative terms) of the basic requirements laid down in the Act. The second

part includes in the Basic Documents (one per each of the basic requirements), methods of verification or compliance and the acceptable solutions, that is to say the fourth and fifth levels in the Nordic code arrangement. Most of this second part was made out of parts still valid taken from the old NBEs. This second part is considered the “official methods of fulfillment” of the performance or functional requirements set in few articles of the first part. So other methods of showing compliance could be used.

In respect to the building control system, the new regulatory framework has lead to an increase of third-party building control, particularly regarding the structural requirements. In case of residential buildings, the developer’s obligation to subscribe an insurance policy guaranteeing structural damages for ten years in residential buildings has lead to an increase of external controls on behalf of the insurance companies. Thus, quality-control companies are carefully checking the fulfillment of the structural part of the code in both projects and works. Insurance for the rest of the requirements is not yet compulsory, although it is being voluntarily adopted by some developers, and most of the regional or municipal housing developers.

ABOUT THE MINISTRY OF HOUSING

Housing policy is one of the Government's priorities as part of its State policy. The Ministry of Housing was created by Royal Decree 553/2004 of 17 April, to be the Department in charge of exercising the powers in matters of housing and land that article 149.1 of the Spanish Constitution of 1978 has assigned to the General State Authority. The Ministry is therefore responsible for the proposal and implementation of Government policy in matters relating to access to housing, either through home ownership or renting, building, urban planning, land, architecture, as well as planning and programming of the corresponding investment in these areas. The national Building Code remains as one of the basic competences of the Central Government although quality in buildings is in the hands of the Regional and Local jurisdictions.

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3.13 TRANSFORMATION OF THE SYSTEM – SWEDEN

HISTORY

Regulations for the whole of Sweden were promulgated in 1960, and were fundamentally prescriptive in nature. Over time, the regulations grew as the prescriptive requirements increased, and in 1988, a significant step towards the use of functional requirements was taken. Since then, considerable work has been undertaken to create functional based requirements that can be verified.

REASONS FOR CHANGE

In the later 1970s and early 1980s, work being conducted within the Nordic Building Code Committee (NKB) indicated that the complexity of buildings was growing, and at the same time, there was a desire to promote more innovation from the clients and the builders. A significant challenge with the prescriptive regulations was the need to always have the right prescriptive solutions, which did not always fit the increasingly complex and innovative building designs. In addition, there was indication of moisture and mould problems in numerous single-family buildings, and it was not clear how closely connected this was to specific prescribed solutions. By making the regulations more functionally oriented, there was the hope that clients, designers and builders would become more proactive in learning about issues and thinking about specific design and building issues, and not always trusting implicitly in the regulatory prescriptions and relying on the authorities to assure designs and construction were correct.

THE CURRENT SYSTEM

The current building regulatory system includes the Act *on Technical Requirements for Construction Works*, (1994:847), the *Ordinance on Technical Requirements for Construction Works* (1994:1215), more detailed mandatory provisions and general recommendations for building construction in the *Building Regulations* (1993:57) and the Design Rules (1993:58) from the Swedish Board of Housing, Building and Planning (Boverket). Regulation concerning road constructions and connecting bridges etc. are given by the Swedish Road Administration, Vägverket The regulatory system for planning, building permits and building

control is found in the *Planning and Building Act* (1987:10) and the *Planning and Building Ordinance* (1994:383).

THE TRANSITION PROCESS

Since 1988 the building regulation system has incorporated more or less functional requirements. However, the Swedish application for membership in the EU led to a total transformation of the former building legislation. When Sweden joined the EU in 1995 the transformation was completed and the Construction Products Directive was implemented by the new building regulations. Nonetheless, the strive for more verifiable functional (or performance-based) regulations continues in a number of areas, including fire safety measures, particularly for building renovation, in the development of functional regulations regarding energy efficiency levels for buildings, and with respect to moisture, the building envelope and interior environment, as a result of problems with mould in buildings brought on by certain facade designs that have not proven to perform as expected over time.

ABOUT THE NATIONAL BOARD OF HOUSING, BUILDING AND PLANNING (BOVERKET)

The National Board of Housing, Building and Planning – Boverket – is the central government authority for planning, the management of land and water resources, urban development, building and housing under the Ministry of the Environment. Boverket monitors the function of the legislative system under the Planning and Building Act and related legislation and proposes regulatory changes if necessary. To ensure effective implementation Boverket also provides information to those engaged in planning, housing, construction and building inspection activities.

In the field of planning and urban development Boverket is responsible for ensuring that ecological, economic, cultural and social aspects are taken into account in planning. The focus of planning is increasingly turning to regional development, sustainable urban development by introducing new planning methods. Boverket is responsible for developing design and building regulations under the Acts and Ordinances decided by the Parliament and the Government. This includes other regulative measures for construction, e.g. rules for certification of qualified persons, Swedish type approval and CE-marking as well as implementation measures concerning EC directives. The Board supports the development of cost and energy efficient, healthy and sustainable buildings as well as accessible public spaces. In the field of housing, Boverket's task is to promote the availability of affordable good-quality housing. Boverket is responsible for ensuring efficient and consistent administration of government subsidies for investment in housing and improved energy systems. Boverket makes long term analyses e.g. with regard to exclusion and availability of housing in different parts of the country.

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The National Board of Housing, Building and Planning

3.14 TRANSFORMATION OF THE SYSTEM – THE UNITED STATES

APPROACH TO BUILDING REGULATION

The building regulatory system in the United States of America (USA) is somewhat unique in comparison to other countries. First, the federal government has no responsibility for and little involvement in the building regulatory process, as building regulation falls under the purview of individual states. Second, although states, and in some cases local jurisdictions, promulgate and enforce building codes, the process involves development of 'model code' by not-for-profit public benefit organizations: entities which are not linked to federal or state government, but instead are private-sector, membership-driven organizations. Third, because individual states legislate for building safety, they follow their own processes and schedules, so even though model codes are available for adoption by all jurisdictions, not all model codes are adopted (or adopted equally). Finally, the model code development process has consolidated from four groups into two groups over the past decade, so changes to the model codes have been primarily incremental, focusing on consistency within prescriptive-based documents, resulting in a slower transformation to performance than in other countries. At present, although model performance-based building codes have been developed, and are available for adoption, the adoption rate is slow, with very few jurisdictions having adopted performance-based building codes, and none enforcing them. This does not mean that a transformation is not underway; rather, the transformation is evolutionary instead of revolutionary, and will require decades to complete.

HISTORY AND OVERVIEW OF BUILDING REGULATORY SYSTEM[28]

Building and fire regulation in the United States of America (USA) predates the formation of the nation, with certain building and fire safety requirements mandated in New Amsterdam (1645), Virginia (1662), Boston (1683), Philadelphia (1696), and Williamsburg (1699) – all well before the Constitution of the United States of America (Constitution) took effect in 1789. Although the Constitution served to bring a number of regulated areas under the jurisdiction of the federal government, building regulation was not one of them.

[28] Much of this section is excerpted from Meacham, B.J., Ed., *Performance-Based Building Design Concepts*, International Code Council, Washington, DC, 2004.

One of the fundamental principles of the Constitution is that only a specific set of powers is delegated to the federal government; all remaining powers are reserved for the people, who, within their states, may delegate any authority they wish to state governments through state legislatures. This was clarified by the Tenth Amendment to the Constitution, which stipulates: "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved for the States respectively, or to the people." An important power that the people have delegated to their respective states, through state constitutions, is police power—states' authority to regulate the health, safety, and general welfare of its citizens. Given that building codes are concerned with the health, safety, and general welfare of the public, police power is therefore the source of authority for states to enact building codes. This power can be delegated further to local or regional governments under what is known as home rule (also referred to as *ultra vires* rule or Dillon's Rule). The net result is that many states had, at some point, delegated authority for building regulation to the county or municipal level.

Throughout early USA history, building regulation, if it existed at all, was a decidedly local issue, which resulted in widely varying requirements, standards and levels of enforcement. However as the USA began shifting from an agrarian society to a heavily industrialized one with the Industrial Revolution of the late 1800s, several new and different health and safety hazards began to manifest, and the shift also increased the size and density of urban areas, which made the risk of a large loss during a single incident, such as a fire or an earthquake, more likely. By the early 1900s, the number, frequency and impact of city-wide conflagrations, major industrial fires and explosions, and related calamity resulted in the insurance industry to publish the *Building Code Recommended by the National Board of Fire Underwriters* (Cote and Grant, 2008). However, application of this code was not required by jurisdictions, and was used more as a tool for the insurance industry to control losses.

As the early 1900s progress, industrial and natural impacts continued to occur, while at the same time advances in building construction were changing the nature of buildings and the safety issues associated therewith. Nonetheless, given the rights of local municipalities to regulate buildings as they saw fit, there was little incentive for local municipalities to coordinate regulations beyond their jurisdiction. To address the new challenges, in an environment where local governments did not have to work together, and with the construction industry seeking some uniformity, building regulators sought to create institutions where they could collaborate and share knowledge. The first such grouping of building code officials was the Building Officials and Code Administrators International (BOCAI), established in 1915, which published the *Basic Building Code* (BBC) in 1950 (the BBC later became the *National Building Code* (NBC)). The second organization of building officials – and the first to publish a model building code – was the Pacific Coast Building Officials Conference (later to become the International Conference of Building Officials (ICBO)), which was formed in 1922 and published the *Uniform Building Code* (UBC) in 1927. The Southern Building Code Congress International (SBCCI) followed in 1940, publishers of the *Standard Building Code* (SBC) in 1945.

In the early days, the model building codes were quite performance oriented, giving general guidance and functional expectations. Over time, the codes and associated standards

became highly prescriptive, in part to assure a common understanding of requirements, compatibility between building systems and technologies, and uniformity in application. By the 1970s and 1980s, however, new materials and technologies made it difficult to capture all building performance using prescriptive language, and means were sought to allow innovative designs. For several years, the 'alternate methods and materials clause' was the primary mechanism for this, since the clause allowed building code officials to accept alternates to the code when they were shown to be at least equivalent to the requirements in the code. Issues still remained, however, since without clear functional or performance objectives in the code, it can be difficult to demonstrate equivalency.

Also during this time, the three model building code development organizations – BOCAI, ICBO, and SBCCI – operated independently, with their respective model codes being adopted on a generally regional basis across the USA (BOCAI in the Northeast and upper Midwest, SBCCI in the Southeast, and ICBO in the West). This was a source of concern for the construction industry, since not only were building codes highly prescriptive and becoming larger and more detailed with each publication, the existence of three model building codes, each being different, coupled with 50 states and thousands of local jurisdictions, resulted in high costs and uncertainty when operating interstate.

By the early 1990s, the complexity and uncertainty in the system resulted in two almost simultaneous activities: the consolidation of the three model building code development organizations into one, and investigation of performance-based approaches as a means to simply building codes. For several decades, the three model building code development organizations – BOCAI, ICBO, and SBCCI – operated independently, with their respective model codes being adopted on a generally regional basis across the USA (BOCAI in the Northeast and upper Midwest, SBCCI in the Southeast, and ICBO in the West). In the early 1990s, agreement was reached to consolidate these organizations into the International Code Council (ICC), which had hopes of consolidating model codes for the built environment. Although the ICC was formed, and publishes the "International" family of model codes, the National Fire Protection Association (NFPA) decided at about the same time to enter the model building code development arena. Thus, although a major consolidation of organizations and model building codes did occur, the net result is two model building codes in the USA instead of one.

Concurrently, the building industry and model code organizations decided to investigate performance-based codes, with both the ICC and NFPA forming committees to develop performance building code language in the late 1990s. By the early 2000s, the ICC and the NFPA had each developed model performance-based codes for adoption in the USA, the *ICC Performance Code for Buildings and Facilities* (ICCPC) and *NFPA 5000, Building Construction and Safety Code* (NFPA 5000), respectively.

Although model performance-based building codes exist and are available for adoption by states and local jurisdictions, the adoption rate has been slow, with very few jurisdictions having actually adopted either the ICCPC or the NFPA 5000. One reason for this is that states and local jurisdictions have been more focused on investigating the differences between the prescriptive codes of the ICC and NFPA, choosing between them, and working them through their adoption processes. Another reason is that there is concern by some in

the building industry that the infrastructure to support performance-based codes – including development and vetting of performance criteria, tools and methods – have not sufficiently advanced to implement codes which require these criteria, tools and methods to be applied (Tubbs, 2004a). As a result, the transition process to performance-based building codes is at the very earliest stages in the United States, and it is envisioned to be several years before more widespread adoption of performance-based building codes occurs.

FACTORS ENCOURAGING THE TRANSITION TO PERFORMANCE

Although the transition is moving slowly, there are a variety of ongoing activities that seem to be nudging the overall building regulatory system in the USA towards performance, albeit in a very fragmented way. These include ongoing development of performance-based guidelines, tools and methods, and tragic events for which performance methods are viewed as one way to better target risk assessment and mitigation based on desired performance.

Development of Supporting Documents

In addition to the publication of the ICCPC, there have been a number of support documents developed that have increased the needed infrastructure for performance regulations and design. For instance, the Society of Fire Protection Engineers (SFPE) published the *SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design* in 1997 (SFPE, 1997; 2007). In 2004, the SFPE and ICC collaborated to develop a *Code Officials Guide to Performance Based Design Review* to help enforcement officials. This document was provided free of charge to all governmental members of ICC. Other documents which are helping include the text, *ICC Performance Based Building Design Concepts* (Meacham 2004), and the *International Fire Engineering Guidelines* (2005), which ICC jointly developed with the Australian Building Codes Board, the New Zealand Department of Building and Housing, and the National Research Council of Canada.

Another activity which is helping is an Applied Technology Council (ATC) project to develop the next-generation performance-based seismic design procedures and guidelines. This project, funded by the Department of Homeland Security's (DHS) Federal Emergency Management Agency (FEMA) has been underway since 2001 and draws on existing work in the area of performance seismic design such as FEMA 368 (2001) and Vision 2000 (1995). A principal motivation for this project is to take earlier work in performance based seismic design and advance it to a more quantitative level that will be more practicable and useable for designers, since the early generation documents lacked the more detailed quantitative aspect needed for practical design.

World Trade Center Investigation

There were many critics who felt that an investigation by the National Institute of Standards and Technology (NIST) of the World Trade Center (WTC) collapse on September 11, 2001 was unnecessary from a technical standpoint since the events of that day do not translate into real world building regulatory issues, the argument being that high-rise buildings have a good safety record, and therefore little could be learned that would be of benefit, and that this was an 'extreme event,' and therefore outside of the bounds of building regulation.

However, the review of the collapse of the World Trade Center has provided benefits to both the regulatory community and engineering community.

For instance, the analysis and recommendations of the report have prompted a detailed study of the use of elevators for egress by the American Society of Mechanical Engineers (ASME). Additionally, during the study of the WTC Collapse NIST's Fire Dynamics Simulator (FDS) was used heavily and was actually developed further to better assist with the analysis. Such improvements and extensive application of such tools translate directly into the needs of everyday designs and to increased acceptance by regulatory bodies. These advances add to the needed infrastructure to support performance regulatory systems and performance engineering in general.

Finally the concept of structural fire engineering has been brought to the fore front as an issue needing attention in the United States and abroad based upon the collapse of the WTC towers and also some testing undertaken in the United Kingdom (Robinson 1994, 1997). This is an area where the current building codes treat in an extremely prescriptive manner in the United States (Tubbs, 2004) and there is no link to the structural requirements within the code. Based upon recommendations of the NIST study several groups have been in the process of pursuing methodologies and standards for structural fire engineering. SFPE is currently in the process of writing two standards reflecting the recommendations of the NIST report and also in the interest of better understanding the actual performance of structures exposed to fire.

It is important to note that many of these issues are also being addressed within the development process of the ICC's prescriptive codes, the *International Building Code* and the *International Fire Code*. For instance proposals to allow a structural fire engineering analysis in lieu of the prescriptive fire resistance requirements was proposed. Though the reaction was fairly negative and the opinion of the committee was that such provisions "belonged in a performance code" it is still interesting to note some of these issues are being discussed at this level. Some recent proposals that have been accepted include elevators designated for Fire Fighters, the requirement for an additional stair in high-rise buildings exceeding 420 feet in height, and more restrictive bond strength for spray applied fire resistance materials.

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ABOUT THE INTERNATIONAL CODE COUNCIL (ICC)

The International Code Council (ICC) was established in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these nonprofit organizations developed the three separate sets of model codes used throughout the United States. Although regional code development has been effective and responsive to our country's needs, the time came for a single set of codes. The nation's three model code groups responded by creating the International Code Council and by developing codes without regional limitations the International Codes.

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4.0 THE ROAD AHEAD

This *Principles and Experiences* document has built upon the 1998 *Guidelines for the Introduction of Performance-Based Building Regulations*, providing new discussion on the fundamental structure of performance-based building regulations, advancing a set of basic technical principles upon which performance-based building regulations are constructed, and providing some insights into how performance-based building regulations have been implemented within IRCC member country legal frameworks. It provides another snapshot in time regarding the evolution of performance-based regulations for the built environment.

However, the IRCC recognizes that even with the advancements over the past ten years, much more is still needed in order to reach the full potential of performance-based building regulations, for example:

- Mechanisms are needed to better define and quantify levels of tolerable building performance, be they in terms of health, safety, welfare, risk, sustainability, or other measures;
- Quantified performance metrics must be developed and incorporated into regulations. Recognizing that some metrics may be best addressed prescriptively (e.g., rise and run of a stair), there remains significant scope for performance measures, for which associated verification methods are needed; and
- Tools and methods for helping with the enforcement of performance-based building regulations are still lacking. In part related to the lack of quantified performance measures, those responsible for approval of designs and enforcement of regulations are faced with the challenge of making decisions in the face of significant uncertainty.

The IRCC has held workshops on some of these topics, including issues around risk concepts in regulations and quantification of fire performance (see www.IRCCbuildingregulations.org); however, these remain challenging topics which require more attention.

In addition, building regulatory systems, policies and components are not static, nor are the drivers of change, from global climate change, to aging populations, to advances in materials and technologies. As countries seek to stay abreast of and address these drivers of change, ongoing effort will be required by regulatory development bodies as they consider whether the regulations and regulatory infrastructure adequately address these emerging societal expectations and requirements for the performance of buildings. Topics currently on the IRCC agenda for discussion include:

- Climate change impacts by and on the built environment, including observed changes, perceptions and expectations around sustainability, resiliency, resource efficiency, and carbon neutrality;
- Transformation of existing buildings, including recycling / reuse of materials as opposed to new construction using new materials, which is often the result of global approaches

to decision–making that include life-cycle analysis and environmental impact of construction work;

- Means to assess and balance the objective of 'preservation of cultural heritage' in the face of sometimes competing and difficult to measure objectives such as occupant, fire and structural safety, energy efficiency, weather-tightness, and accessibility;
- Impacts associated with urban densification, changing demographics and taller buildings, including use of elevators for evacuation;
- The impact of changing demographics on building regulation, from design for aging in place, to accommodating a less fit and more culturally diverse set of building users;
- Housing affordability; and
- Security.

In recognizing these needs, the IRCC has adopted the challenge of working to advance the understanding of, and facilitate the transfer of knowledge regarding, emerging issues and pressures being faced by building regulation, including defining the problem within the context of building regulation, identifying research and development needs to address the emerging issues, and advancing concepts and approaches aimed at facilitating the development of performance-based building regulatory systems to address these needs.

The IRCC also recognizes that there is significant benefit in creating a document that looks into these emerging issues and suggests strategies for addressing them. To this end, the IRCC is in the process of developing a document on *Emerging Issues and Approaches*, which will address performance building regulatory issues that are just now, and anticipated to be, coming on the building regulatory agenda, along with possible approaches to addressing these issues.

Together, the *1998 Guidelines*, this *Principles and Experiences* document, and the forthcoming *Emerging Issues and Approaches* document are offered as a means to help all countries struggling with the issues of performance-based building regulatory systems through the collective experience and perspectives of the IRCC.

ANNEX A – DEFINITIONS

Acceptable Solution (Approved Document, Deemed-to-Comply): A solution that has been determined by the authority having jurisdiction (AHJ) to comply with the *societal goals*, *functional objectives* and *performance requirements* stated within a *performance-based regulation*. These may be specific *prescribed/specified* solutions, provided in or referenced by the regulation, or *performance-based* solutions derived using *verification methods* provided in or referenced by the regulation.

Alternative Solutions: A solution that differs, in part or in whole, from the solutions offered by the *acceptable solution* or *verification method*, but achieves compliance with the performance requirements of the building regulation to the satisfaction of the AHJ.

Annual building warrants of fitness: A declaration by the building owner stating that the specified systems have been maintained in accordance with the Compliance Schedule.

Approved Method of Analysis: The process or method that is required to be followed for determining acceptability of an *alternative solution* when an *acceptable solution* or acceptable *verification method* is not applied.

Authority Having Jurisdiction (AHJ): That body deemed by government to have jurisdiction over building consent / approval within a particular jurisdiction (building consent authority, building control officer, building code official, fire code official, territorial authority, etc.).

Building permit (consent): A document granted by a government agency which conveys permission or consent to construct a specific project on a specific site under the terms of the permit or consent.

Building Regulation (Building Code, Building Standard): Legal instrument intended to ensure that buildings, when constructed in accordance with the regulations, provide socially acceptable levels of health, safety, welfare and amenity for building occupants and for the community in which the building is located. This is typically accomplished through regulatory controls on the design, construction and operation of buildings, covering such diverse areas as structural stability, fire safety, heating, lighting, ventilation, plumbing, sanitary facilities, indoor air quality, and energy.

Certificate of Occupancy/code compliance certificate/building work completion certificate: A document granted by the appropriate government agency which warrants that the building complies with applicable regulations and is suitable for occupancy or use.

Compliance Documents: Details for construction that, if followed, result in compliance with the building regulation.

Compliance Schedule: A document which details the inspection, maintenance and reporting requirements and status of specified systems critical for the ongoing compliance with the expected performance of a building, such as sprinkler systems and fire alarms.

Code of Practice / Engineering Practice: A document which lays out principles of good practice, in a particular discipline, which provides guidance but is not necessarily legally enforceable.

Descriptive (Prescriptive) Requirement: A requirement expressed using definitions, particular (product) types or classes, or design features.

Determinations/Rulings/Interpretations: A determination is a binding decision made by the legal authority, such as the promulgator of the building regulation, which provides a way of solving disputes or answering questions relating to the building regulation.

Engineering Practice / Code of Practice: A document which lays out principles of good practice, in a particular discipline, which provides guidance but is not necessarily legally enforceable.

Function-Based: Being described in terms of the function intended to be achieved through the use of a material, product, component or system.

Functional Objective: A statement of how a building or its systems function to meet a *societal goal* for the building.

Functional Requirement: A requirement expressed using only *qualitative* terms, and stating a goal or objective which shall be achieved (e.g., “buildings shall have escape routes which allow users to leave the building sufficiently quickly and safely, taking into consideration its purpose and size, and whether emergency equipment can be used”).

Guidelines: Non-regulatory documents which supplement performance-based building codes or regulations, explaining the requirements in more detail and setting out procedures for the documentation of compliance.

Licensed Building Practitioners: Any professional architect, contractor, engineer or other building professional who has been licensed under appropriate legislation to undertake design or construction services appropriate to their expertise and scope of license.

Legislation (Statutory Law): Law which has been promulgated (enacted) by a legislature or other governing body. The term may refer to a single law, or the collective body of enacted law, while "statute" is also used to refer to a single law. Under the Westminster System, an item of legislation is known as an Act of Parliament after enactment.

Legislature (Parliament, Congress, Diet): A type of representative deliberative assembly with the power to create, amend and ratify laws. The law created by a legislature is called legislation or statutory law.

Objective: Goal or objectives the building must achieve.

Objective-Based: Being described in terms of an objective or intent to be achieved through the use of a material, product, component or system.

Prescriptive-(Specification-) Based: Being *prescribed* or *specified* in terms of dimensions, materials or operation.

Performance-Based: Being described in terms of the performance of a material, product, component or system which can be measured, calculated, or predicted.

Performance-Based Building Regulatory System: A regulatory framework for the built environment which consists of 1) a *performance-based regulation* (code), 2) *acceptable solutions*, 3) *verification methods*, and *approved methods of analysis*.

Performance-Based Regulation (Code): A document that expresses requirements for a building or building system, in terms of *societal goals, functional objectives* and *performance requirements,* without specifying a single means for complying with the requirements. *Acceptable solutions* and *verification methods* for demonstrating compliance with code requirements shall be referenced by the code. (This definition also applies to *objective-based regulation (code)).*

Performance Criteria: *Quantitative* metrics against which building materials, assemblies, systems, components, design factors and construction methods will be evaluated on their ability to meet specific *performance requirements* by calculation, testing or simulation (application of *verification methods*). For example, tenability limits, escape time, structural loads, energy loads, that must not be exceeded.

Performance Requirement: A requirement expressed using *quantitative* terms, and the fulfillment of which can be determined by calculation, testing or simulation (application of *verification methods*). Performance requirements should provide the basis for evaluating how the building design and features will meet the *societal goals* and *functional objectives*.

Product certification: A scheme that will enable product manufacturers to have their products certified as meeting nominated performance requirements of the building regulations.

Private building certifiers: Private building professionals (non-government), who through appropriate legislation, have been granted authority to certify compliance with the building regulation (code) and to issue code compliance certificates.

Qualitative Requirement: A requirement which is stated in qualitative or descriptive language, typically relating to the quality or character of something, rather than to its size or quantity.

Quantitative (Requirement): A requirement which is capable of being expressed in numerical terms or estimated, measured or predicted using a *verification method* or other method deemed acceptable by recognized *guidelines* and *approved methods of analysis*.

Regulation: Legal restrictions promulgated by government authority. A *regulation* is a form of secondary legislation which is used to implement a primary piece of legislation appropriately, or to take account of particular circumstances or factors emerging during the gradual implementation of, or during the period of, a primary piece of legislation.

Risk: The potential for realization of an unwanted event, which is a function of the hazard, its probability and its consequences.

Risk-Based: Method or technique which uses quantitative risk data as the basis for decision making.

Risk-Informed: Method or technique which considers qualitative and quantitative risk information as an input to a decision-making process.

Societal Goal: Broad policy statement that reflects society's expectation of the level of health, safety or amenity provided in a building. These statements, although generally qualitative, should be stated in such a manner that compliance with the goal can be evaluated using *acceptable solutions*.

Standard: A consensus document that provides a set of rules, conditions, or requirements concerned with: definition of terms; classification of components; delineation of procedures; specification of dimensions, materials, performance, design or operations; description of fit or measurement of size; or measurement of quality and quantity in describing materials, products, systems, services or practices. (These may be written in mandatory or non-mandatory language.) Standards used in building regulation cover a range of topics but are usually in one of the following categories:[29]

- Test or measurement standards that provide information on the acceptability (pass/fail), performance category usually under some standard condition (e.g., Class A, 1-hour), or to provide data that can be used to determine acceptability or performance;
- Procedural standards that detail with how products or systems are to be installed, used, maintained, tested, or operated to be fit for the intended use, safe or reliable;
- Interoperability standards that set out a procedure or arrangement that allows products to fit or work together; and
- Standards of professional practice, generally accepted methods of analysis or design, qualifications, processes and documentation thereof.

Statute: A formal written enactment of a legislative authority that governs a country or parts thereof (state, province, territory, municipality). Typically, statutes command or prohibit something, or declare policy. The word is often used to distinguish law made by legislative bodies from the judicial decisions of the common law and the regulations issued by Government agencies. Statutes are sometimes referred to as legislation.

Verification Methods: Calculation, simulation or test methods that prescribe one way to comply with the building regulation. Verification methods can include: calculation methods, using recognized analytical methods and mathematical models; laboratory tests, using tests (sometimes to destruction) on prototype components and systems; tests-in-situ, which may involve examination of plans and verification by test, where compliance with specified numbers, dimensions or locations is required (non- destructive tests, such as pipe pressure tests, are also included).

[29] Bukowski, R. (2002). "The Role of Standards in a Performance-Based Building Regulatory System," *Proceedings, 4th International Conference on Performance-Based Codes and Fire Safety Design Methods*, Society of Fire Protection Engineers, Bethesda, MD, USA.

ANNEX B – LEGAL PRACTICES IN IRCC MEMBER COUNTRIES

B2.3.1 DEVELOPMENT ROUTES VARY, BUT PROMULGATION IS BY GOVERNMENT

DEVELOPMENT BY NATIONAL GOVERNMENT

China

The Construction Law 1997 is the principal building control legislation in China and is enacted by the National People's Congress, the supreme law-making body of China. The State Council formulates administrative regulations in accordance with the Constitution and the Construction Law 1997. Likewise, the Ministry of Housing and Urban-Rural Development (MOHURD), formerly named the Ministry of Construction (MOC), formulates the department rules under and pursuant to the Construction Law 1997 and the State Council's administrative regulations, decisions and decrees. The Construction Law 1997, the administrative regulations and the department rules contain administrative provisions including the building control procedures, the duties and liabilities of all responsible entities, and the penalties when the provisions are overridden, etc., whereas the building standards and codes (referred to hereafter as 'building standards') provide technical requirements. The MOHURD is responsible for the development and enforcement of the building standards. The building standards contain both mandatory and voluntary requirements except the Residential Building Code 2005 which is the first and only full mandatory code up to now. All the mandatory requirements in the building standards comprise the technical building regulations in China.

England and Wales

The principal legislation in England and Wales allowing building standards to be set is the Building Act 1984, as amended. The Sustainable and Secure Buildings Act 2004 made a number of substantive amendments to the 1984 Act. The Building Regulations 2000, as amended, and the Building (Approved Inspectors etc) Regulations 2000, as amended, set out the functional requirements and the procedures to be followed in detail. A series of Approved Documents give official guidance on ways that the functional requirements can be complied with.

Japan

The principal legislation of building construction in Japan is the Building Standard Law (BSL). The BSL, enacted by the Diet (Parliament), regulates basic items related to the rights and obligations of people, and contains administrative provisions, building and planning codes. The regulation of requirements and procedures are stipulated in cabinet orders, ministerial orders and ministerial notifications, all of which are mandatory documents that function integrally (referred to hereafter as 'the BSL and regulations'). The development and enforcement of the BSL and regulations is by the central government's Ministry of Land, Infrastructure, Transport, and Tourism (MLIT), which is responsible for building and housing policy.

the Netherlands

The technical building regulations in the Netherlands are laid down in the Building Decree. These are uniform and performance based regulations on the national level, which all works must comply with. Based on the Housing Act, which itself does not contain technical rules, the building Decree is a general administrative order, issued by the central government. In the Building decree standards play an important role. These standards have been adapted in the requirements and contain the determination methods, by which one can check if a structure complies with these requirements.

New Zealand

The Building Act 2004 is the primary piece of building control legislation in New Zealand and is set by the national Parliament, the supreme law-making body of New Zealand. National Building Regulations are made under and pursuant to the Building Act 2004. The Governor-General (the Sovereign's representative) is responsible for making regulations acting on the advice of Government Ministers. The national Building Code (the Code) is included in these Building Regulations. The Code contains performance requirements that all building work (including construction, demolition and alteration work) must comply with.

Norway

The Planning and Building Act is the legal basis for spatial planning, planning, procedural rules, building control and technical requirements enacted by Parliament. The act covers all aspects of building and civil engineering works - public and private. The Ministry of the Environment administers spatial planning, whereas the Ministry of Local Government and Regional Development is responsible for the remaining parts. The Ministries do also have the task of adopting regulations. The National Office of Building Technology and Administration has the task of preparing the regulations for adoption and producing the guidelines. From past experience a new act is passed every 20 years, new regulations every 10 years, and guidelines undergo major revisions every 5 years. Minor revisions will be undertaken at shorter intervals as required. A new act and a complete set of new regulations will be passed in 2009.

Scotland

The Scottish Parliament has devolved powers under the Scotland Act 1998 to make laws covering, amongst other things, building standards matters in Scotland. The building standards system in Scotland is established by the Building (Scotland) Act 2003 and is independent of the other British jurisdictions. The Act gives powers to Scottish Ministers to make building regulations, procedure regulations, fees regulations and other supporting legislation as necessary to fulfill the purposes of the Act. These purposes include setting building standards and dealing with dangerous and defective buildings. The various regulations are made by the Scottish Ministers but must be approved by the Scottish Parliament before coming into force. The building regulations, and the supporting guidance documents on how to meet the regulations, are subject to scrutiny by the European Commission and the member states of the European Economic Area. The legislation is applicable to the whole of Scotland, including the Scottish islands.

Singapore

The principal legislation for the building control system in Singapore, namely the Building Control Act, and its subsidiary legislations are enacted by the Singapore Parliament. Approved documents and guides are developed by the Building and Construction Authority. The Singapore Standards and Codes of Practice are developed by the Standards Council of SPRING, which is a statutory Board under the Ministry of Trade and Industry. In the absence of Singapore Standards, the relevant British Standards and Codes of Practice are acceptable.

Spain

As said before, the basic legislation in Spain is the Building Act 1999. It was set by the Spanish Parliament ("Cortes Generales") and entered into force in May 5th 2000. The Act established that a new Building Code had to be approved by the Government in the short term. Statutory administrative provisions are approved by Royal Decrees agreed by the Council of Ministers. The ministerial Department responsible for the Code development and new proposals is currently the 'Ministry of Housing' (Ministerio de Vivienda) through the Directorate General for Architecture and Housing Policy.

After several Building Code drafts prepared, managed, publicly consulted by the competent Ministry between 2001 and 2004, finally the Code was approved by a Royal Decree of the Council of Ministers in March 17th 2006. This Decree authorizes the Minister of Housing to approve amendments to the Code Basic Documents by means of Ministerial Orders. The approval of new Basic Documents or Part one amendments have to be made by a new Royal Decree of Council of Ministers. So, in this way, in October 2007, a new Basic Document on Noise Protection was approved by a new Royal Decree superseding the old acoustical regulations. The same is going to happen with the scheduled document regulating the requirements on Accessibility which will supplement the existing Basic Documents on Safety in Use and Fire protection. The Code is structured in two parts. Part I refers to the general and administrative provisions as well as the Basic Requirements (see discussion in 2.3.8).

Sweden

All building regulations are national. All Swedish laws (Acts) are decided by the Parliament. Ordinances by the Government and more detailed mandatory regulations within the higher ranking regulations area are given by legally empowered sectorial national authorities working under the Government. These authorities may also give non-binding guidelines on how to ensure compliance with the sectorial regulations respectively. In the building area, different climate zones, snow loads etc. within the Swedish territory have implications on the energy efficiency in buildings and on load bearing constructions. The regulations therefore consider these facts. The building control authorities are municipal (local). Minor deviations from the general regulations may be accepted by the municipal authorities if the construction project may nevertheless be assumed to be technically satisfactory.

DEVELOPMENT BY REGIONAL GOVERNMENT AND ORGANIZATION WORKING FOR GOVERNMENT

Austria

Austria is a federal state, and the building regulations are issued by each federal province independently. As a rule, building regulations comprise a law and related ordinances, and it is the responsibility of the provincial parliaments to pass such laws. The ordinances are issued by the provincial governments directly. Whereas the procedures and functional requirements have been mostly covered by the laws, the technical requirements (prescriptive and performance based) have been set by the ordinances. At present the system is being changed. In the future (for most of the provinces starting in 2008 or 2009) the detailed technical requirements will no longer be set by ordinances, but by guidelines issued by the Austrian Institute of Construction Engineering (OIB), a private institution founded by the provincial governments, which have also transferred certain duties to OIB. The ordinances of the provincial governments will therefore in future just refer to the guidelines issued by the Austrian Institute of Construction Engineering (hence "OIB-guidelines"), which will also be made compulsory by the ordinances. It will be possible to deviate from the OIB-guidelines, when an equivalent level of safety can be demonstrated. The OIB-guidelines themselves can also further refer to Austrian standards and other technical documents.

DEVELOPMENT BY ORGANIZATION WORKING FOR GOVERNMENT

Australia

Australia is a federal state. Under the Australian Constitution, building regulations are the responsibility of the eight States and Territories, and each has its own Building Act or principal building law to establish the building control system within its jurisdiction and to call up the applicable technical building standards. Each State and Territory Building Act calls up the national Building Code of Australia (BCA) as the applicable technical standard. The BCA is developed and maintained by the Australian Building Codes Board (ABCB), which is a joint initiative of all levels of Australian Government and includes representatives from the building industry. The ABCB was established in an inter-government agreement signed by the Australian Government and State and Territory Ministers responsible for building regulatory matters in March 1994 and reaffirmed by Ministers in April 2006.

Canada

Canada is a confederation of 10 Provinces and 3 Territories. Under Canada's Constitution Provinces and Territories have authority for enacting regulations for building construction and safety. Over the years all provinces and territories have developed a partnership with the National Research Council of Canada (NRC) for the development, use and adoption of model National Code Documents—National Building Code (NBC), National Fire Code (NFC) and National Plumbing Code (NPC) as basis for their regulations. NRC is the Government of Canada's premier organization for research and development, which has over 20 research centres around Canada covering life sciences, physics, engineering, technology and many

other sectors (www.nrc-cnrc.gc.ca). This partnership between NRC and the provinces and territories led to the establishment of a national system for model code development and maintenance (www.nationalcodes.ca). Established by the NRC, the Canadian Commission on Building and Fire Codes (CCBFC) is responsible for developing and updating Canada's model National Code Documents.

The CCBFC sets priorities and direction and oversees the work of technical committees and task groups involving as many as 300 volunteer members. The system is structured such that it is the members of the CCBFC and its committees, not NRC, who establish the content of the model codes. Member expertise from industry, the regulatory community and general interest groups is balanced to ensure that all relevant sectors and geographical areas of the country are represented. In 2001, as part of the improvements to the code development system, the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC) was formed to provide policy advice to the CCBFC. All 13 provincial and territorial jurisdictions are represented on PTPACC. Through a partnership with NRC and the CCBFC the provinces and territories participate in every step of the national model code development process.

This broad consensus based code development process also includes public review of all proposed changes to the codes and all public comments are considered by the CCBFC and its committees. NRC provides administrative, technical, research and financial support to the national code development system and to the CCBFC and its committees through its Institute for Research in Construction (NRC-IRC) (http://irc.nrc-cnrc.gc.ca).

DEVELOPMENT AT ALL LEVELS AND WITHIN PRIVATE SECTOR

USA

The United States of America (USA) is a federal union of states. Under the Constitution, the authority to regulate health, safety and welfare of people in buildings is delegated to each state, which can in turn delegate that authority to local government (see more detailed discussion in Section 3). As such, development of building regulations is a responsibility of state and local governments. Until the early 1900s, there was no uniformity in building regulation across the USA. Over time, and driven in large part by insurance and building design professionals, private-sector organizations were created to develop model building codes, which were available for adoption by local and state governments. At present, a large number of local and state governments across the USA adopt building and related codes developed by the International Code Council (ICC), although some municipalities continue to develop their own.

Within the ICC code development process, any interested individual or group may submit a code change proposal and participate in the proceedings in which it and all other proposals are considered. This open debate and broad participation before a committee comprised of representatives from across the construction industry, including code regulators and construction industry representatives, ensures a consensus of the construction community in the decision-making process. Voting members may either ratify the committee's recommendation or make their own recommendation. The results of all votes are published in the report of the ICC code development hearings.

Once the recommendations of the committee are published any interested party may submit a public comment which is basically a challenge to the committee's decision. These public comments are then published in a Final Action Agenda. Eligible voting members review the recommendations of the ICC code development committee and any public comment that has been submitted in the Final Action Agenda and determine the final action for each proposal. Following consideration of all public comments, each proposal is individually balloted by the eligible voters. The final action on the proposals in based on the aggregate count of all votes cast. Currently each cycle is 18 months from the deadline for the initial proposals to the hearing of the public comments at the Final Action Hearings. Once a cycle is complete it results in either a Supplement or new Code edition. The codes are published every three years.

B2.3.2 PROMULGATION NATIONALLY, REGIONALLY, LOCALLY OR IN COMBINATION

PROMULGATION BY NATIONAL GOVERNMENT

China

The Construction Law 1997, the administrative regulations and the department rules are all set at a national level and are implemented across the nation. The MOHURD exercises unified supervision over and administration of the construction activities throughout the country.

The national building standards, among which some requirements are mandatory, are approved and promulgated by MOHURD and implemented all over the country. China has a large population and significant variation in geographical and climatic conditions across the country. The national building standards give basic principles and requirements for all administrative areas. The provincial construction authorities have the power to issue local building standards according to their particular needs, usually based on geographic or climatic reasons. The local standards, which are implemented in each respective province, usually have more detailed and stricter requirements than those of the national standards. The local standards can also contain their own compulsory provisions, but those compulsory provisions should be subject to scrutiny by MOHURD or its designated organization before publication.

England and Wales

Promulgation of the building standards is done nationally although inspection and enforcement is carried out locally by local authorities or approved inspectors.

Japan

The Japanese administrative system is divided into two parts: central government and local governments (47 prefectures and approximately 1,800 municipalities). As the law of the central government, the BSL covers all regions of Japan and its administration is carried out by local governments as stipulated by the BSL and regulations.

However, the actual levels of the requirements are not necessarily uniform over the entire country since they are determined in accordance with regional conditions. For example, structural calculation is performed using figures specifically determined by regional conditions such as snow accumulation, wind pressure and seismic force. With regard to fire safety, specific regulations apply to specific zones taking into account the conditions of the zones like the density of buildings. How to decide figures and how to divide zones are set by the BSL and regulations, based on which local governments actually carry out administration. In addition, local governments may, within specific limits and within the scope of not disrupting the safety of buildings, set more severe or more relaxed regulations than the standards applied throughout the country.

the Netherlands

The most important three administrative layers in the Netherlands are the central government, the twelve provinces and presently about 430 municipalities. The government is responsible for the Dutch building regulation system. The Building Degree is the central document for the technical requirements. Based on the Housing Act, which itself does not contain technical rules, the Building Degree is a general administrative order, issued by the central government. With regard to some subject, the Degree authorizes the Minister of Housing, Physical Planning and Environment to give further rules by ministerial order. A typical exponent of the Dutch 'polder model' is the Consultation Platform Building Regulations. This platform consists of representatives of all parties within the building sector and functions as an advisory board. The platform discusses the future development of the Dutch system of building regulations and advises the Minister of Housing, Physical Planning and Environment.

Provincial government have limited responsibilities in housing, but are involved mainly through their competencies in approving municipal land-use plans, their drawing-up of structural (regional) planning documents and their mainly redistributive function of central state means for urban regeneration in smaller towns and villages. Municipalities are expected to devise land-use plans within their boundaries and to develop housing visions. And municipalities are responsible for the quality of the housing within their borders, carried out by local building control.

Additionally to the Building Decree, a multitude of other quality marks or certificates for housing related aspects exist in the Netherlands. These can be obtained voluntarily by (potential) buyers, tenants, owner-occupiers, construction firms and project developers. The marks concern the quality of hidden or apparent deficiencies of new or existing dwellings, burglar-resistance of dwellings (provided by the police), sanitary facilities, central heating installations, boilers, building materials, energy efficiency, the quality of services of realtors,

valuers, notaries, mortgage intermediaries and banks, care and welfare providers, and of housing associations and other landlords.

New Zealand

The Building Act 2004 provides the mandatory framework for the building control system and applies throughout New Zealand. All building regulations, including the Code, apply across all areas of New Zealand. Provisions contained in the Building Act and associated regulations are mandatory, however, decisions on individual projects are made by municipal or regional government. Examples include the decision to issue a building consent or code compliance certificate and the decision to exempt certain building work from the consent requirements. The Building Act also contains provisions known as waivers and modifications, which allow municipal or regional authorities to provide some flexibility in the enforcement of the requirements of the Code. New Zealand has a relatively small population and has a generally temperate climate. National regulation is therefore more cost effective than local or regional regulation. While the building regulation applies to the whole country to achieve a uniform outcome, the design capacity of a building differs depending on location to account for differing temperatures, seismic risk and wind and snow loads.

Norway

All parts of the building code, and regulations on procedural rules and building control apply equally to all parts of the country. Norway is sparsely populated with 430 local authorities enforcing the legislation within their jurisdiction. The climate varies from arctic to mild coastal and inland climate. There may be local by-laws approved by the ministry, but such by-laws are deemed not to have a technical content. The powers of the local government to deviate from the Building Code are limited. A second tier (regional) government has certain powers but to all intensive purposes only act as an appeal body to local government decisions. Planning is an integral part of building control. Wind and snow loads will vary throughout the country, based on charts set out in the Norwegian standards, whereas all other requirements apply equally.

Scotland

Scotland has nationally set building regulations made under the Building (Scotland) Act 2003. The Building (Scotland) Regulations 2004, as amended, contain 17 regulations, and apply to the design, construction or demolition of a building, the provision of services, fittings or equipment in or in connection with a building and the conversion of a building. The ninth regulation introduces the mandatory functional building standards.

Scotland is a relatively small country geographically, with mix of dense urban areas and large expanses of sparsely populated rural landscape. The climate also varies to some extent, being generally colder in the north than the south and wetter in the east than the west. This may lead one to the conclusion that local regulations may work better than national ones, however, due to the size many, even relatively small building, architectural or engineering firms cover the whole of the country. It is therefore felt that a nationally set and uniform system benefits the whole construction industry by allowing a consistent response

from local authority verifiers. Local variations can and are built into the system by the use of, for example, wind and flood plain charts.

Singapore

Legislation for the building control system in Singapore is developed and administered by the national government. The principal legislation is the Building Control Act, which is passed by Parliament. Subsidiary legislation is enacted in the form of Building Control Regulations and powers to make Regulations are granted under the Act to the Minister of National Development.

The power to administer the Building Control Act and all the Regulations made under the Act is granted by the Act to the Commissioner of Building Control, who is appointed by the Minister. The Act also empowers the Commissioner to direct the powers conferred and the duties imposed on him under the Act to be exercised and carried out by public officers or a public authority. Currently, the Commissioner is an officer in the Building and Construction Authority (BCA) and the BCA is designated to be the public authority to administer the building control system.

For compliance to the legislative requirements, generally all Singapore Standards and, in the absence of Singapore Standards, the relevant British Standards and Codes of Practice are acceptable. An Approved Document prescribes acceptable solutions to performance-based design. In administering the Act and Regulations, BCA also makes guidelines or codes pertaining to requirements under the legislation.

The building control system administered by BCA does not cover planning or development aspects, which are covered under a separate legislation (Planning Act) that is administered by another public authority. Similarly, other aspects that may be covered under building control in some countries, like fire safety, sewerage, drainage and transportation, come under other legislation that are administered by other public authorities. Nevertheless, BCA works closely with the other authorities to ensure that appropriate regulatory measures on safety (such as fire safety and pollution control) and amenities (such as drainage, access roads, parks, etc) have been provided.

Spain

In Spain there are three regulatory levels. The hierarchy is as follows: national or state level, regional (17 autonomous communities, and local authorities (more than 8300 municipalities). The national level gives basic regulations for all national territory that may be complemented by the lower authorities, which have the power to implement its control of fulfillment or even reinforce them according to their particular needs, which is rare. The local authorities are responsible for the building and planning control, issuing of building permits, etc. They can also set local ordinances in some fields that can complement the code requirements.

PROMULGATION BY REGIONAL GOVERNMENT

Australia

Australia is a federal state. Under the Australian Constitution, building regulations are the responsibility of the eight States and Territories, and each has its own Building Act or principal building law to establish the building control system within its jurisdiction and to call up the applicable technical building standards. Building regulations consist of:

1. The State and Territory Building Acts or primary building law (head of power and administrative provisions), which establishes inter alia, the building control system in the jurisdiction, the need for lodging building plans for approval/review, the rights and responsibilities of building practitioners, the need for inspections/certification of the work, enforcement and appeal procedures; and
2. The technical building standards, namely the Building Code of Australia (BCA).

The primary building law is the responsibility of each of the eight States and Territories under the Australian constitution. Under an agreement between the Commonwealth, State and Territory Governments which establishes the Australian Building Codes Board, the Board is responsible for administering and maintaining the BCA. All States and Territories, the Commonwealth, local government and industry are represented on the Board. All States and Territories adopt the BCA but they are able to vary it where there is a specific need, usually based on geographic or climatic reasons.

Austria

Austria is a federal state, and the building regulations are issued by each federal province independently. As a rule, building regulations comprise a law and related ordinances, and it is the responsibility of the provincial parliaments to pass such laws. The ordinances are issued by the provincial governments directly.

PROMULGATION BY REGIONAL AND LOCAL GOVERNMENT

Canada

The Constitution of Canada gives the ten provinces and three territories jurisdiction over construction, and some cities also have this authority through a special relationship with their provincial authority. All 13 provincial and territorial jurisdictions are partners of the national model code system with NRC and the CCBFC. The national model codes developed by the CCBFC form the basis for provincial and territorial building and fire regulations in Canada. To enact building and fire regulations, the provinces, territories, and municipalities pass legislation that references either the relevant model national code or a provincial code that is based on the relevant model national code.

In using the model national codes for their regulations provinces and territories may make modifications or additions to suit their specific regulatory needs. The timelines and mechanisms for adopting and updating building regulations also varies from one jurisdiction to another.

The authorities having jurisdiction are responsible for:

- Enforcing regulations and arranging for inspections (these responsibilities are usually delegated to municipalities);
- Providing interpretations of the codes within their jurisdictions;
- Education and training of building, fire, and plumbing officials and of professionals and trade workers; and
- Licensing trades and professions.

In some provinces, municipalities are prohibited from introducing higher requirements than those contained in the provincial code. In other provinces, municipalities have the right to impose higher criteria, but not lower.

United States of America

The United States of America (USA) is a federation of states. Under the Constitution, the authority to regulate health, safety and welfare of people in buildings is delegated to each state, which can in turn delegate that authority to local government. As such, promulgation of building regulations is a responsibility of state and local governments.

B2.3.3 VERIFICATION REGIMES

AUSTRALIA

Each Australian State and Territory government has its own Building Act or primary building law to regulate the administrative provisions dealing with the application and enforcement of the national Building Code of Australia (BCA). While there are some differences between jurisdictions, by and large the following apply throughout Australia:

- The Building Acts call up the BCA as a mandatory code;
- Except for minor building work, plans for the proposed work must be submitted to the local council or to a private building certifier for assessment/approval prior to work commencing. Western Australia is the only State which does not yet permit private certification but proposes to in 200;
- Building control officers must be qualified, and private certifiers must be licensed by government and carry professional indemnity insurance. Private certifiers are audited by government;
- The council or private certifier can inspect the work during construction and can rely on certification of the work by engineers or other appropriately qualified persons;
- On completion of the work, the building (except for minor buildings) cannot be occupied unless the council or private certifier has certified the building is suitable for the intended use (e.g., all fire safety and health aspects are installed and operational);
- In most cases, the building owner is primarily responsible for compliance with the building regulations. Where the building work does not comply, the council or private certifier can issue notices and instigate legal action;

- The building owner or representative can appeal to non legal technical review body (or a court in some States) where there is disagreement with the council or private certifier; and
- Most States have requirements in building regulations or other laws (e.g., fire safety laws) requiring the building owner or lessee to maintain the building to ensure all safety features remain operational to the standard applicable at the time of building approval.

AUSTRIA

In Austria, building control is performed by the building authorities. Private experts or private institutions are only involved in certain cases, which can either be on behalf of the building authority, or contracted by the builder (building owner) as provided for in the procedural regulations. This differs, however, from province to province. Verification is done in most of the cases through an assessment of the designs, and only in few cases (e.g., for larger or more complicated projects) by additional inspections on site. Only registered designers, contractors and specialists are allowed to be involved. The professional requirements for those registered designers, contractors and specialists are relatively high in Austria (professional education at secondary or university level plus several years of professional experience plus additional examination). Assessment is done before the work starts, hence building permits can be seen as “design permits”. After completion, in most of the provinces a confirmation of the builder is required that all legal requirements as well as conditions and orders of the building permit have been duly respected.

CANADA

In Canada, the approval processes and the documentation required by these processes vary from jurisdiction to jurisdiction. This is because the model national codes are given legal effect by regulatory legislation in each province and territory. In most provinces and territories the responsibility for verifying compliance and approval of buildings solutions to regulations and issuing building permits is delegated to the municipal governments. The approach taken by provinces and territories has varied somewhat, but in general municipalities have responsibility for land use planning, enforcement of construction codes, maintenance and occupancy regulations for existing buildings, licensing of businesses and establishing limits on noise, hours of work, etc. Many provincial and territorial governments do however retain a certain degree of involvement or control in the approval process or criteria for large, high risk or high occupant load buildings.

It is generally the applicant’s responsibility (owner, designer, supplier, etc.) to provide sufficient evidence to the authority having jurisdiction (AHJ) that proposed work complies with building regulations. The construction industry in Canada benefits from a well established building product voluntary standardization system. Although not specifically required by the model national codes demonstration of compliance to building product standards is generally accomplished by obtaining a certification mark or report from an accredited certification agency or other credible third party. Several certification agencies are accredited by the Standards Council of Canada (SCC) (www.scc.ca).

Code enforcement usually consists of a system of required permits - issuance by the AHJ is often conditional on acceptance of plans, and successful inspection reports. In one province a government appointment industry council covering 9 safety disciplines is responsible for accreditation of municipal governments and certification of individual “officials” with authority to carry on verification, inspection and approval duties and issuance of building permits.

CHINA

The Construction Law 1997, the administrative regulations and the department rules mainly regulate the administrative provisions during the full building process, and require the relevant building standards to be implemented. At different stages, the verification of compliance with the administrative provisions and the mandatory requirements of building standards can be ascertained in different ways and forms. The main verification activities are listed as follows:

- The planning permit for building project must be obtained;
- The execution drawing of the building must be inspected and approved by designated organizations;
- Except for small-scale building projects, application for a construction permit must be submitted to the local construction authority prior to construction;
- All responsibility entities engaged in building operations must have relevant qualifications prescribed by regulations. Specialized technical personnel engaged in building operations must obtain appropriate qualification certificates;
- The builder must carry out inspection over the building materials, components and fittings and equipment. Those that fail to pass the inspection shall not be used;
- The innovative construction methods and/or building products that do not conform to the mandatory requirements of building standards shall be demonstrated to achieve the same level of performance as required;
- The building control officers and supervisors on behalf of the building owner can inspect the work during construction and can ask the builder to make corrections, when they decide that building work does not conform to design requirements;
- After completion of the work, the building shall not be handed over for use unless it has been confirmed to be suitable for the intended use through acceptance inspection;
- All involved parties engaged in building operations may apply for quality system certification and/or product quality certification to third-party certification body approved by government; and
- All involved parties engaged in building operations may apply for quality system certification and/or product quality certification to third-party certification body approved by government.

ENGLAND AND WALES

Verification that building work has met the required building standards in England and Wales is carried out by one of three ways:

i. Inspection by a building control body. There are two sorts of building control bodies in England and Wales – local authorities or private approved inspectors. At certain defined stages during the course of building work and at its completion the building control body will inspect the work carried out and come to a view on whether it complies fully with all applicable requirements in the Building Regulations. It is for the building control body concerned to decide how much inspection a particular building project needs, usually based on the degree of risk. Where a local authority considers that the work complies it can give the person carrying out the building work a completion certificate attesting to that fact. Approved inspectors give a final certificate for the same purpose.

ii. Where building work is carried out by a person registered with an authorized competent person self-certification scheme there is no requirement to notify a building control body of the work. The registered person has the right to self-certify that the work complies with all applicable building regulations requirements. To join a competent person scheme a person must demonstrate appropriate qualifications, knowledge and experience to carry out the type of work for which they seek the right of self-certification to the standards required by the Building Regulations. The operators of competent person schemes must undertake periodic random monitoring of the work of persons registered with the scheme to make sure that the work they do does comply.

Where work is carried out by a person registered by a competent person scheme building control bodies are authorized to accept the self-certificate of compliance as evidence of compliance. Local authorities retain their right to inspect the work and take enforcement action for non-compliance but this right is normally exercised only in response to a complaint.

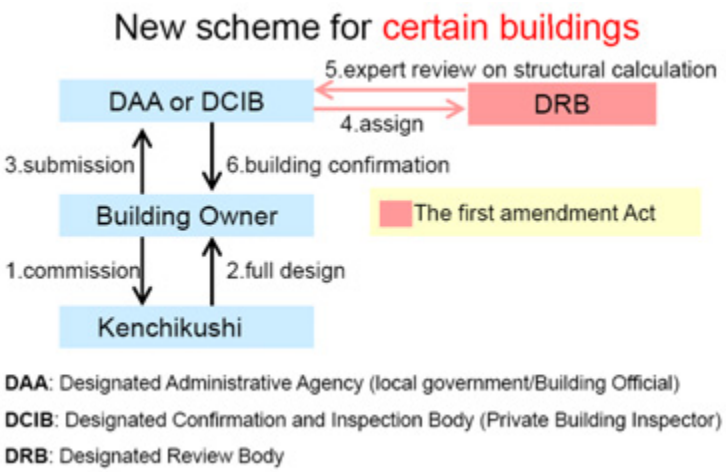
iii. Robust details. In order to improve standards of acoustic insulation between dwellings, a requirement to carry out sample testing of dwellings at completion was introduced in 2003. Whilst this did have a significant impact on standards of sound insulation it also introduced a significant commercial risk for house builders.

As an alternative to testing, a scheme of approved robust details was introduced in 2004. A robust detail is a design detail that is not overly sensitive or susceptible to poor workmanship. Where a robust detail is used the requirement for testing is waived. However the design performance of these details is set much higher than the normal performance standard and there is an extensive monitoring program to ensure that standards are achieved. The monitoring program provides a feedback loop to the scheme and details are modified or removed where problems occur. The scheme is independently operated, financed by users of the approved details and by manufacturers of products featured in them.

JAPAN

Under the BSL, a building owner is required to obtain a building confirmation, which is similar to building permit, for the building plan before starting construction work (with the exception of certain small-scale construction work). It will be given only if the building plan conforms to the BSL and regulations. As part of the 1998 revision of the BSL, the building

confirmation system by private sector was introduced and was enforced in 1999. Since then, a building confirmation has been issued by a building official of a local government or a Designated Confirmation and Inspection Body (hereafter 'building official etc.'). The verifications of compliance with building regulations are basically conducted by these building officials etc. However, they do not verify 'alternative solutions'.



A building or a part of the building that uses innovative construction methods and/or building materials that do not conform to technical requirements stipulated in the BSL and regulations must obtain ministerial approval which will be given based on performance evaluation. Performance evaluation tasks are delegated from the MLIT to Performance Evaluation Bodies that are considered to have high levels of technical expertise as well as a fair and unbiased testing framework. The ministerial approval can be issued not only to individual construction project but also to building method, material and product. As for the latter, the approved method etc. can be used nationally for building parts where the same level of performance is required.

In addition to the above, as part of the 2006 revision of the BSL that aimed to prevent the recurrence of the falsification of structural documents, the structural calculation review system was newly introduced. From June 2007, structural calculations of buildings excluding technically simple cases must be verified by Designated Structural Calculation Review Bodies or prefectural governors (hereafter 'structural calculation review body etc.') during the process of building confirmation.

THE NETHERLANDS

Every municipality must provide in some way an organization that performs the task that are led down in the Housing Act. Most municipalities have a department of local building control. The most important task is the provision of building permits and checking that designs and construction comply with the requirements of the Building Degree.

There is a general administrative order in which the submittal demands are formulated. It is uniformity and all municipalities in the Netherlands should have the same demands for the application for a building permit. The order describes in detail the documents and documentation that have to be submitted. It also explains the way the documentation and documents have to be delivered. In its other function the local building control checks whether the building activities complies with the relative Building Decree regulations. Ordinarily these inspections are carried out as a result of complaint by tenants.

In the Netherlands the controls are partly contracted out to private engineers, although the local building control keeps the responsibility and will decide about the scope of the controls.

NEW ZEALAND

There are essentially three forms of verification regime in relation to building control in New Zealand. Verification of building work for compliance with the Building Act and Code is the most substantial and significant part of building control. The Building Act 2004 has introduced two other verification regimes: restricted building work and product certification.

Building work verification

Building work, including design of proposed building work, is verified for compliance with the Code (design stage) and the building consent (construction/completion stage) by building consent authorities (municipal, regional authorities or private companies). Ongoing verification (inspection and maintenance) of certain building work systems (specified systems) are covered in the compliance schedule and building warrant of fitness regime. This regime ensures certain life safety systems (such as lifts, fire alarms, and sprinklers) continue to perform to the standards they were installed to. Inspection and maintenance is carried out by independently qualified persons (IQPs).

IQPs are currently assessed and registered as competent by municipal authorities, the Building Act allows this system to be nationalised.

Restricted building work

Restricted building work is building work which is critical to the integrity of a building and can be both elements of a building and certain building types. Restricted building work can include design and construction work. Details of what is restricted building work are to be contained in subordinate legislation which is yet to be developed. Only certain licensed building practitioners will be able to carry out or supervise restricted building work. The licensing scheme (administered by the Department of Building and Housing) assesses competency of practitioners on the basis of qualifications, skills and experience. The Building Practitioners Board is an independently acting board whose role includes hearing complaints about licensed building practitioners. If a complaint is upheld, the licensed building practitioner may face a range of penalties, including being ordered to undertake further training, restrict the type of work they carry out, pay a fine up to $10,000, and have their licensing suspended or cancelled.

Product certification

The Building Act 2004 also introduces a voluntary product certification scheme which enables product manufacturers to have their products or systems certified as meeting the requirements of the Code. A building consent authority must accept a certified product as meeting the requirements of the Code when assessing an application for a building consent. Products will be certified by a product certification body that is accredited by an independent accreditation body.

NORWAY

Plans are to be submitted to the local government. They will issue a building permit in whole or in parts and a completion certificate. The local authority will also approve all companies accountable to the local authorities for each project and is also responsible for the surveillance of accountable control bodies in each project. Local authorities may inspect a project at any stage at their discretion.

Accountable companies will be approved in the following categories: overall application (including an obligation to ensure that all parts are covered by a control plan) design, control of design, execution and control of execution. All categories, with the exception of accountable applicant, may be subdivided into different disciplines. Project documents shall be produced on demand and are to be presented in such a way as to trace any fault back to the accountable company. The completion certificate is issued on the basis of declaration of completed control plans. Accountable companies are approved subject to competence as laid down in the regulations and the presence of a working quality system. There is a central approval system administered by the National Office of Building Technology and Administration, which forms the basis for the local authority approvals. The obligation of the building owner or client is limited to not commencing work without a permit, and to ensure that he contracts competent companies.

Verification will most commonly be done by the accountable designer or an independent control body through acceptable or alternative solutions with reference to building code guide lines, national standards (NS) or Building Research Digests. Design by analysis or part analysis will generally be limited to larger projects. The local authority may prescribe independent control for the works in part or as a whole.

SCOTLAND

The enforcement of the requirements of the Building (Scotland) Act 2003 is carried out by the 32 local authority verifiers responsible for work carried out in their own geographical area. Enforcement work relates to work being carried out without, or in contravention of, building warrant approval; it also covers dangerous or defective buildings and the enforcement of continuing requirements. This work is treated separately from verification work and is funded from central government rather than from building warrant fees.

The Scottish building standards system is pre-emptive in that building warrant approval is required before any works commence on site. The responsibility rests with the owner of the building to ensure that a building warrant has been obtained prior to any works commencing and that a completion certificate has been accepted by the verifier prior to the building being occupied.

Verifiers are appointed by Scottish Ministers; their role is to issue building warrants and accept completion certificate submissions. Although the Act provides for a variety of verifiers to issue building warrants and accept completion certificates, at present the only appointed verifiers are the 32 local authorities, again each covering their own geographical area. Whilst the people carrying out the verification process within the local authority may well be the

same people that carry out the local authority's enforcement role, they are two effectively unrelated processes.

The Act requires the verifier to grant a building warrant if it is satisfied that the work will be carried out in accordance with the building regulations. They are also required to accept a completion certificate submission after making reasonable inquiries to confirm that the building complies with the building warrant and the regulations. The means of satisfying itself in either of these instances is for the verifier to determine but is normally based on risk assessed processes.

There is also a system of Approved Certifiers that allows members of an approved certification scheme to issue certificates of design or construction in respect of designated constructions or parts of the regulations. Where a certificate of design is provided in support of a building warrant application, the verifier is required to accept it as proof of the adequacy of the design covered by the certificate. Where the verifier is advised in advance of work commencing on site that a certificate of construction is to be submitted with a completion certificate, these works do not require to be inspected. Certification schemes are approved by the building standards division but are operated by limited companies.

SINGAPORE

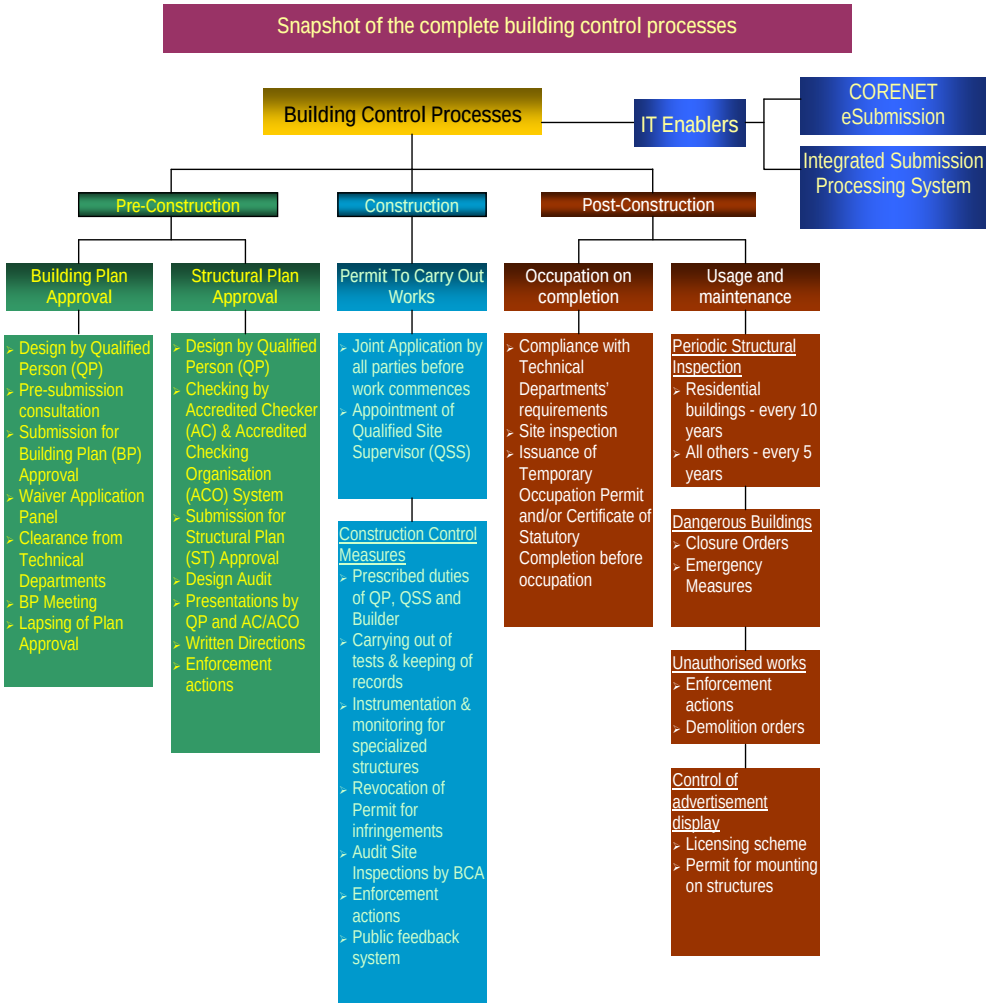
In Singapore, authority related to building control rests on the government and is administered by the Building and Construction Authority, which grants various approvals needed for design, construction, occupation, maintenance and demolition of buildings.

As many aspects of a building development are regulated by various regulatory agencies (or technical departments), the BCA also acts as the main coordinating agency to ensure that requirements of these agencies have been complied with before a certificate of completion is granted. In order not to delay the development process, parallel submission to technical departments for clearance is made possible.

Verification that building control requirements meet compliance is made through visual screening of all plans, design audit checks of key elements and site inspections at critical stages of construction by BCA. However, the building control system depends, to a large extent, on certifications by qualified professionals performing key professional roles - such as carrying out the design, supervising the construction, inspecting completed works and performing maintenance inspections - which are crucial to achieve a safe built environment. As structural safety is paramount, structural design has to be independently checked by an Accredited Checker (which is a peer review system to minimize the risk of design errors arising from lapses on the part of the design professional engineer). The building control system allows the BCA to grant approvals based on these professional certifications, including certifications from the Accredited Checkers, and these professionals can be prosecuted if they fail in their duties, which are prescribed in the Building Control Act and Regulations.

These qualified professionals are licensed by several regulatory agencies, and they comprise:

- architects who are registered and licensed by the Board of Architects;
- professional engineers who are registered and licensed by the Professional Engineers Board; and
- accredited checkers and accredited checkers organizations who are registered by the BCA.



Generally, approvals to design using acceptable solutions are granted based on certifications by the relevant professionals. For designs using alternative solutions, the BCA would normally require verification on compliance by another professional or expert that the BCA deems qualified to make such verification. For product verification, the BCA may accept test results from testing agencies that are accredited by the relevant authorities.

SPAIN

In the verification system the central Government does not intervene. The government licensed practitioners are the main actors in the process. Architects or in some cases engineers have almost all the building control responsibilities. The public control in building is quite simple and it happens normally for issues such as fire requirements undertaken by

the municipal technicians or fire services. The building permit issuing means overall the compliance with urban planning requirements. The municipalities require a formal checking or 'visa' of the project documents (plans and specifications) realized by the Architect's local Associations, as it is explained in 2.3.4. Some parts of the building regarding safety, like electrical installations, lifts, gas installations and alike are also formally registered and checked by the relevant regional services or agencies on behalf of the autonomous communities with full competences in this matter.

SWEDEN

Building control is a matter for the municipal authorities. The building control system relies strongly on a self-control system within the organisation of the commissioner of the construction works. This person, normally the future owner of the building/works, is responsible for compliance with the requirements in the national building regulations. However, minor deviations from the general regulations may be accepted by the municipal authorities if the construction project may nevertheless be assumed to be technically satisfactory. The building control system, and other areas of the planning and building regulative system is now discussed on a political level. The Government is expected to suggest amendments late in 2009.

USA

Compliance with building regulations in the USA occurs primarily at the local level. As noted previously, the states have been granted the police power from the federal government to regulate the safety of its citizens, and therefore building regulations are both adopted and enforced on a state or local level.

Building and Fire Officials

The primary enforcer of the building regulations tends to be the building official. There are many terms used to represent the authoritative body for which the building official works (e.g., Building Department, Building and Planning, Planning and Economic Development, Public Safety, etc), but there is generally a position of building official, it is the role of persons in these positions to enforce the requirements in the building regulations. The structure and staffing of these departments varies widely based upon the size and structure of the community in which the department is located. In some jurisdictions the fire official (typically the fire prevention department or fire marshal) is given the authority to review aspects of the building that are related to fire safety and fire protection such as the sprinkler design and installation. The building official's office may be supported by plan reviewers and inspectors to ensure compliance is met. The level of detail that such officials review designs and plans varies based upon the size and staffing level of the department. Many smaller departments simply depend on the qualifications of the designers as long as appropriate documentation of their qualifications is presented. In other jurisdictions detailed plan reviews are undertaken and in some locations structural, mechanical and fire protection engineers are on staff that review detailed design calculations.

Review and Acceptance of Performance-Based Designs

In the United States these entities are still primarily working with prescriptive codes, but do encounter alternative designs, often termed 'equivalencies.' These designs can pertain to all areas of the codes including structural and fire protection engineering. The level in which these designs are reviewed and how they are approved varies significantly. In general there remains some fear of approving such designs, in part due to lack of clear guidance, expertise and education. Smaller jurisdictions, for example, typically do not have the staffing and either will reject the design, look to a third party reviewer or simply depend upon the qualifications of the designers. In other more heavily funded and staffed departments they may do in house design reviews or look for a peer review on the design. Depending on the infrastructure and comfort level with performance designs the approvals process will vary widely. For instance, Clark County Nevada and the City of Las Vegas are very accustomed to unique designs and have a specific protocol and procedure whereas a small jurisdiction that has not been exposed to performance design will have no procedures in place to address the review of such designs. To help address some of these issues with respect to fire safety, the ICC, along with the Society of Fire Protection Engineers (SFPE), produced the *SFPE Code Official's Guide to Performance-Based Design Review*.

Private versus Public Enforcement

Privatization of building departments and fire departments, or of their functions, is not typical in the USA, although some departments seek outside assistance with plan review services and inspections. The ICC Performance Code encourages the use of peer review and contract review services when a jurisdiction feels they do not have the qualifications to review a particular design. This is, of course, the decision of the jurisdiction as to how they approach such situations. Special inspection requirements may also necessitate the use of third party inspection agencies, especially since the required expertise may be specialized. There is an ongoing debate whether architects and designers in general should be able to self certify their building plans.

Refer to the text, *Building Department Administration*, 3rd Edition (ICC, 2007), for an in-depth treatment of building control systems and responsibilities in the USA.

B2.3.4 STAGE IN THE BUILDING PROCESS WHERE VERIFICATION OCCURS

AUSTRALIA

Verification is required (except for minor works) before construction begins, during construction, and when construction is complete (before occupation). Verification of the building in use is also a feature in most States and Territories. People involved in the construction and approval/assessment process are usually required to be licensed or registered in each State and Territory (although some differences occur between jurisdictions). For example, building control officers and private certifiers are required to be licensed or registered by State/Territory governments. The top level certifier usually requires a university degree in building surveying or similar. Structural, mechanical, electrical or fire engineers, and architects usually require a university degree and

registration. Builders, plumbers and electricians usually need to be registered/licensed by the State government to be able to enter into a contract with a future building owner or undertake work. People who inspect buildings in use or test fire safety or other systems in accordance with legal requirements are also usually required to be licensed or registered. Many building professionals, builders, and trade contractors belong to professional or industry associations and are bound by the association's code of ethics in order to remain a member.

AUSTRIA

Normally there is only an assessment of the design, and only for larger and/or more complicated projects inspections on site are performed. In order to make inspections at the right time, the building authority can oblige the builder to notify to the building authority when certain stages of the construction process have been achieved (e.g. completion of the foundation, placement of the reinforcement etc.).

CANADA

Owners do not have the right to build until they have been given permission. In general, it is municipalities who process building and plumbing permit applications. Municipal building and fire department staff also play a large role in education -- particularly for individuals building their own houses, renovating home owners, and some companies who are new to the process. In most jurisdictions, the building verification and approval process will include verification at the design stage, during construction and before occupancy.

For building solutions that comply with the building regulations verification of compliance is normally done at the municipal level by the authority having jurisdiction (AHJ). Liability implications associated with acceptance of alternative solutions is becoming a growing concern in Canada. Where the AHJ has appropriate competence and experience, they may undertake the assessment and approval of the alternative solution. In some cases they may refer the assessment of the proposed alternative solution to a third party. If the applicant wants to use a non-standard item, the building official will review tests, specifications, engineered design, evaluation reports, etc., as appropriate, to determine equivalence. As an example, the Canadian Construction Materials Centre (CCMC) was established by NRC in 1988 to help manufacturers demonstrate conformity of their new innovative construction products and systems to the codes. CCMC evaluation reports provide an impartial opinion that is used by regulatory authorities in making decision on the acceptability for code compliance of new products and systems that are not addressed in the codes (http://irc.nrc-cnrc.gc.ca/ccmc). The final acceptance of an alternative solution results from an assessment by the AHJ, and may in some cases require prior acceptance by provincial or territorial boards or commissions.

CHINA

As a rule, the stages where verification occurs include design, construction, acceptance, use and maintenance. The planning permit and construction permit must be obtained before

starting building work. The execution drawing shall be inspected by a professional institution designated and licensed by government. Prior to execution drawing inspection, anti-earthquake and protective control of high-rise building must be inspected by corresponding committee of experts organized by the building control authority at provincial level or national level, if that high-rise building exceeds limits stipulated by regulations.

During the construction work, the building control officers and supervisors on behalf of the building owner can inspect the work when the construction reaches certain stages such as completion of foundation, placement of reinforcement, etc. Once the work is completed, acceptance inspection is carried out and if the finished work complies with the regulations and standards, the building can be delivered for use. Once a building is put to use, regular inspection and maintenance shall be carried out. The type and frequency of inspection shall comply with the regulations and standards.

The persons involved in the certification activities shall obtain appropriate qualification certificates and be registered by the building control authority. In most cases, they are required to meet criteria such as certain educational background, working experience and must pass an examination.

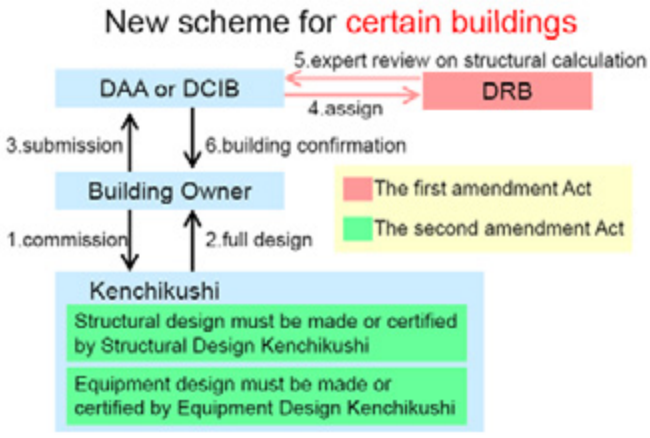
ENGLAND AND WALES

Full verification normally occurs at the completion of building work. However, partial verification may occur at other stages:

- Where full plans of building work are required a building control body will verify that the work, if carried out according to the plans is likely to comply with the relevant requirements; and
- Where the local authority is the building control body persons carrying out building work have a duty to notify the local authority of certain stages of the work, for example, before foundations, damp proof courses, sewers and drains are covered up. The local authority may inspect at this stage and verify that the work concerned complies. Approved inspectors would normally choose to carry out inspections at these same stages.

JAPAN

A building owner is required to obtain a building confirmation for the building plan before starting construction work with the exception of certain small-scale construction work. Also, as a rule, the relevant building is required to pass final inspection before it can be put to use. During the construction work, there are cases where interim inspections by building officials etc. are required when



the construction reaches certain stages that are set in accordance with the size, structure and intended use of the building. In principle, buildings and stages requiring interim inspection are specified by local governments. However, as part of the 2006 revision of the BSL that aimed to prevent the recurrence of the falsification of structural documents, interim inspections for apartment houses with three or more stories were mandated throughout the country, which was enforced in June 2007.

There are qualification systems for the persons involved in the building confirmation process including Kenchikushi who are in charge of design and 'superintendence', building officials etc. and structural calculation reviewers. To practice, they are also required to meet certain criteria. The Kenchikushi Law regulates Kenchikushi qualification. To be licensed, an applicant must have certain educational background and working experience and must pass an examination. The qualification of building officials etc. and structural calculation reviewers are stipulated in the BSL and regulations. To obtain the qualification, an applicant must have Kenchikushi license and certain working experience and must pass an examination.

THE NETHERLANDS

To get a permit for a given application, the building regulations make a division into three categories. Construction works that are permit free, construction works that need a permit and construction works that need a permit following a ‘light’ instead of the ‘regular’ procedure.

Once the application is submitted and is considered as complete by the municipal building control, the checking process starts. Applications for a light procedure will be checked on their external appearance (aesthetic check), the planning and zoning demands and the demands in the Building Decree concerning structural safety. Regular permits are checked completely, but with the Housing Act a phased procedure is possible. The applicant decides whether to choose a phased procedure or not. In phase one the special quality is checked: external appearance; zoning plan; and monuments permit. In the second phase the construction is checked with the requirements of the Building Decree and on ground pollution.

Building can start when the applicant receives a building permit for the first and second phase. The city council can claim back a permit for the first phase if the applicant does not submit an application for a permit for phase two of the building procedure. This system has been chosen to prevent a situation in which municipalities are haunted by decisions from a distant past. Once the construction work has started the local authorities select strategic construction phases to inspect. Unlike most other European countries the Netherlands do not generally have a completion certificate. However, buildings where the public interest is concerned (e.g. buildings that are accessible to public visitors), may only be used after a permit is issued. Dutch government policy encourages normalization and certification. Wherever possible the government will recognize and reward private law certification as an alternative to public testing and controls. Self regulation and certification are seen as important instruments in the achievement of further deregulations and both the reduction of

management costs and the pressure of regulations in citizens and companies. Accreditation is of great importance in guaranteeing the quality and recognition of certificates.

NEW ZEALAND

The stages of verification for the three regimes are described below.

Building work verification

A building consent must be applied for before building work can be carried out. An application will include plans and specifications detailing proposed building work which will checked by the building consent authority to ensure that, if the proposed building work was built in accordance with the plans and specifications, it would meet the Code. Once this is confirmed the consent is granted and construction can begin. Inspections are carried out at various stages during the construction process to ensure what is built complies with the building consent. How many and how often these inspections are carried out is at the discretion of the building consent authority. Once the work is complete a final inspection is carried out and if the finished work complies with the consent, a code compliance certificate is issued verifying this compliance. Ongoing inspection and maintenance of specified systems is carried out at various stages during the year. The type and frequency of inspection is determined by the compliance schedule which is issued with the code compliance certificate when the building work is complete. Certificates and a building warrant of fitness must be supplied by the building owner to the municipal authority annually to verify compliance with the compliance schedule.

Restricted building work

If a building consent includes restricted building work, a memorandum (from the design licensed building practitioner) will have to be provided with the consent application. stating that if the restricted building work is built in accordance with the plans and specifications the restricted building work will comply with the Code. The system is currently projected to come into effect after November 2010.

Product certification

A product certification body will have to conduct an audit of a certified building product on an annual basis.

NORWAY

Verification will normally apply to the design stage and the control of the design. For larger projects design and execution will overlap. Contractors are obliged to ensure that their work has been adequately designed. All deviations from submitted design and execution shall be recorded and notified to the local authorities. If the local authorities, whether electing to examine plans or performing random checks during construction or when examining the control procedures, finds cause for concern, they may prescribe independent or alternative control of any discipline at any stage. New regulations to be passed in 2009 will put far more emphasis on independent control for designated disciplines.

SCOTLAND

As the Scottish building standards system in pre-emptive it is an offence under the Building (Scotland) Act 2003 to commence works that require a building warrant without first obtaining consent. The applicant may also apply for a staged building warrant covering part of the proposed construction, for example, the foundations and under-building. This would enable works to commence on site in relation to the parts approved, with further submission(s) being made as the design or process progresses.

The verifier assesses the adequacy of the design against the requirements of the building regulations and may request such information as is required to enable this assessment to be made. The adequacy of the qualifications and experience of the personnel working for the verifier is a matter for the verifier to determine. However, as part of the audit process of verifiers, the robustness of the system in place to distribute and monitor work is examined.

The verifier should be advised within 7 days of the commencement of any work for which building warrant is required. On receipt of this advice the verifier would be expected to determine what inspection regime would be appropriate to enable them to accept the completion certificate when it is submitted. The adequacy of the risk protocol adopted for this process would also be examined at the time of the audit.

SINGAPORE

The building control system in Singapore covers the whole life cycle of the built environment - from design, construction, usage and maintenance to demolition. Consequently, verification of compliance is prescribed at various stages of a building's life cycle.

All building works, except a small group of minor works (which are listed in the Schedule of the Building Control Regulations as exempted works as they do not involve major structural safety issues) require prior approval of plans and a permit from BCA before construction work commences. Failure to do so will attract penalties which include either monetary fine or custodial sentence or both. For plan approval, the professionals are required to submit their design calculations and drawings to the BCA for approval. BCA carries out random audit checks on design compliance although approvals are generally granted based on certifications by the professional who undertakes the design and accredited checker who undertakes the independent checking (in the case of structural designs except for prescribed minor works). To help professionals ensure that compliance can be met, BCA allows pre-consultation on the proposed design.

Upon the approval of the structural plan, a permit to carry out structural works has to be obtained from BCA before construction work can commence. Application for the permit is made jointly by the developer, the qualified person (registered professional engineer and registered architect) and the builder. For structural works, the qualified person needs to appoint a supervision team to help him in supervising the structural works. The supervision team comprises resident engineers and resident technical officers, the composition of which

depends on the value of the building works. The qualified person, his supervision team and the builder have statutory duties which include carrying out inspections of critical structural elements, carrying out prescribed tests, and maintaining site records. BCA officers carry out random inspections of construction sites as another measure to ensure that the work processes meet the regulatory requirements.

When the building works are completed, the developer and qualified person are required to apply to BCA for a grant of a Certificate of Statutory Completion before the building can be occupied. At this stage, BCA acts as a coordinating agency to ensure that clearances from all the Technical Departments (covering regulatory areas such as fire safety, pollution control, drainage, access roads, parks, etc) have been obtained before allowing occupation. For large developments where it may take time for the project parties to obtain all the clearances from the Technical Departments, BCA may issue a Temporary Occupation Permit if all the major requirements, especially those involving safety, are complied with.

To ensure that buildings are properly maintained and remain fit for occupation throughout its intended life span, all buildings (other than temporary buildings and landed residential houses (i.e. single-owner homes) such as detached, semi-detached or terraced or linked houses) have to be inspected by qualified structural engineers at regular intervals. Buildings which are used solely for residential purposes (for example, condominiums and apartments) are to be inspected every 10 years, while all other buildings (such as offices, factories and schools) are to be inspected every 5 years. Reports from the professionals making these inspections (including recommendations for rectification or strengthening works) have to be submitted to BCA for approval. Where a building is to be demolished, a permit is also required from BCA.

SPAIN

The way building control is performed in Spain differs from other European or western countries. It relies in the qualification of professionals, normally architects who respond of the quality of the process and account on the building quality. Once a client hires the architects' services to prepare a certain project of a building, and the project is finished, it has to be checked by the local architect association, which performs a first control of the formal content of the project documents, according to the applicable regulations (zoning, building code and other regulations).

The architects fees, once regulated by a Decree and now deregulated, have to be paid to the professional through to the Architects Association which charges a commission for the control made ('visado'). This checking means also that the professional is registered and is entitled for practicing as an architect according to the Spanish legislation. So any authority cannot issue any building permit on any project without the professional association 'visado'. Apart from that and since the entry into force of the Building Act and its compulsory decennial insurance police underwritten by a residential building promoter, there is a new indirect checking on projects quality regarding the structural safety issues. The insurance companies before insuring any building works ask for a 'building control' performed by Control Bodies, that are private companies that check plans and calculations of the structural parts of the building before the works start. During the construction process they

make some other controls granting at the end of them a favorable opinion to the insurance company which then issues the insurance policy for ten years.

SWEDEN

Construction works shall be constructed and executed in such a way that the finished works comply with the essential technical requirements, according to the building regulations. This means that the commissioner of the works – who is responsible for compliance – is responsible for verification during the whole building process in order to be able to verify the finished result of the building project. Building authorities (on a municipal and local level) need only be given notice three weeks ahead of the actual building process start. (Building permits are decisions on the placing and outwardly design of buildings and certain civil engineering works). If it is not deemed obviously unnecessary the Building Authorities shall call for a meeting with the building commissioner (the future owner normally) and his appointed accredited Quality Manager and discuss the planning of the building project and the planning of the commissioner's own building control management. Building control management plans are obligatory if not obviously unnecessary. Authorities may accept the suggested plan or ask for the strengthening of the commissioner's own administration by additional documented inspections and control by independent certified professionals. The municipal authorities may decide on different sanctions if the works are deemed not to comply when finished. If necessary, Building Authorities may also decide on sanctions during the building process such as stopping the ongoing work until the shortcomings are corrected.

The political conviction that the commissioner of the work is the one who has the greatest interest in a compliant and thus technically adequate building is one of the main reasons for introducing the "new" building control system in 1995. This relies heavily on the commissioners own verification and management system. Moreover the former building regulations unfortunately prescribed some technical solutions which later proved to be wrong. This caused litigation processes and the Parliament and the Government had to introduce State Aid for corrective building measures. The then existing building control system which included the attestation by authorities on technical methods etc. was thus strongly questioned. Nowadays the efficiency of the building control system is again being discussed and the Government is currently working on amendments of the laws on this matter.

USA

Verification occurs at various stages in the building control process, and to differing degrees of detail, driven in part by the building type and size, as well as the size and sophistication of the building department or authority having jurisdiction. The reader is referred to the text, *Building Department Administration*, 3rd Edition (ICC, 2007), for an in-depth treatment of this topic.

In general, the process involves reviews of permit applications and plans, issuing of a permits, review of construction, and issuance of a certificate of occupancy. The specifics of building plan and design approval varies due to the staffing level of the department and the type, and size and significance of the building, but in all cases follows local legislation.

For example, the process for a single-family dwelling may involve review of general plans and inspection of specific details, such as structural loading, electrical and plumbing systems. A larger, commercial building housing several small businesses, such as a coffee shop, a hairdresser and a stationary store, might have more iterations of plan review and inspection, with a large casino, which is much more complex and houses a large number of people, would typically require more reviews and special inspections. This is particularly true if a performance-based alternative is being sought.

When an owner and designer are proposing a design using a performance-based approach, it is advisable, and in some jurisdictions required, that designers meet with authorities at the conceptual stage. In some cases, preliminary reports which encompass the intended design approach and/or mitigation alternatives must be submitted (e.g., fire engineering design briefs, life safety analyses, etc). For more complex buildings and designs, more intense construction inspections and commissioning testing is required as well. In some cases, the jurisdiction may require an external, expert peer review in addition to the governmental plan review and inspections. Private certification is generally not allowed. Self-certification by licensed design professionals is possible in some jurisdictions for certain types of projects.

B2.3.5 DISPUTES RESOLUTION

AUSTRALIA

Most States/Territories have a non-legal appeals body to resolve disputes between applicants for building approval and the council or private building certifier. Some States (e.g., Queensland) have a fast track system where appeals are decided within two business days. Some States (e.g., Victoria) have a peer review body where performance assessments can be reviewed and decided by an expert panel. Other States (e.g., New South Wales) have a right of appeal directly to a court. In general, a non-legal appeals body works well as the issues are generally of a technical nature relating to compliance with the building code rather than a strictly legal issue. Also, keeping matters out of the courts, without the need for legal representation, enables a quicker, more accessible and cheaper appeal opportunity.

AUSTRIA

The first instance of decision is the building authority (i.e., in chartered towns the municipal administration, and in other towns and rural communities the mayor), the second instance of decision is the town government (senate) or the board of the community council respectively. Furthermore the supervising authority (provincial government) can be appealed to, and finally the highest administrative court or the constitutional court, depending on the matter of appeal. However, neither the provincial government, nor the highest courts would

decide on the case, they can only confirm or abolish the decision (building permit) made by the first or second instance. Through a constitutional reform which is under discussion at present, the system could be changed in future (introduction of special administrative courts in the provinces).

CANADA

The approval processes and the documentation required by these processes vary from jurisdiction to jurisdiction in Canada. Because building regulation is a provincial and territorial jurisdiction all disputes over code interpretation and approval of construction works are handled within the jurisdictions. The NRC and CCBFC play no role in dispute resolution other than providing an opinion on the intent of the model national code when requested. Most parties involved in the construction process are tied by contractual agreements. Standardized contracts are widely used and help resolve disputes. Contracts would normally include a clause that the work will be done in accordance with codes and other applicable laws.

For example a number of problems can be identified and resolved during the course of construction by the contractors' site supervisors, and by the owner's designers. Most disputes are resolved by the owner's representative. More serious ones can be pursued by the parties through mediation or in the courts. Someone who suffers damages may have rights to claim back against responsible parties through contract obligations. Where insurance or bonds have been provided, covered parties may also be able to claim back against those instruments.

Code requirements will in most cases be the subject of additional inspections by the authority having jurisdiction over building. Serious contravention can result in stop work orders, and may be pursued by the government through the courts to make sure the project does not proceed until it is brought into conformity with the code. As above, owners or contractors who suffer damages may have rights to claim back against others involved in the construction.

CHINA

All parties involved in the construction process are bound by contractual agreements, which normally include a clause specifying that the work shall be done in accordance with the regulations and standards and relevant dispute resolution procedures. In most cases, disputes are resolved through negotiation between the involved parties. Because most standards are prescriptive, it is easy to resolve the disputes by simple measurements or reviews. More serious disputes either go to arbitration or go to court. Arbitration is normally charged by a third party, and the assessment as to the extent of compliance is reviewed and decided by an expert panel arranged by the third party. In that case, the interpretations of the building standards from its management organizations are very helpful to dispute resolution, but management organizations only provide an opinion on the intent of the building standards when requested. In general, the disputes pertain to technical issues relating to compliance with the building standards. It would be practical to resolve the

disputes by drawing a conclusion based on opinions from management organizations of building standards rather than going to court.

ENGLAND AND WALES

In most case the decision of a local authority on compliance is final. However, in certain circumstances there are other options open:

- Where a person carrying out building work and a local authority cannot agree whether the plans for work would comply it is possible to ask the Secretary of State for a determination on whether the work would comply if carried out according to the plans;
- Where work has been completed and in the opinion of the local authority it does not comply, the person carrying out the work is entitled to ask the local authority to relax or dispense with a particular requirement. If the local authority refuses it is possible to appeal to the Secretary of State against that refusal;
- Local authorities have powers to prosecute a person carrying out building work for contraventions of the requirements of the Building Regulations. Such cases are heard in the Magistrates Court which would then determine whether a contravention has occurred;
- Local authorities also have powers to serve a notice on the building owner requiring non-compliant work to be brought up to the required standard or pulled down. The building owner has a right of appeal to the magistrates' Court against such an order. A further appeal may be made to the Crown Court; and
- Where a building owner and an approved inspector cannot agree on whether building work would or does not comply it is open to either party to cancel the approved inspector's initial notice and return the matter to the local authority. Where this occurs any of the above options would apply.

JAPAN

In Japan, building confirmation is considered to be fundamentally 'non-discretionary action.' As part of the 1998 revision of the BSL, performance based codes (PBC) were introduced to the building codes and enforced in 2000. At that time, to avoid broadening the range of judgment of building officials etc, the specific provisions (DTS provisions) and concrete verification methods were specified in the BSL and regulations. For any alternative solution that the above measures are not applicable, the ministerial approval system was established. The approval is to be issued based on performance evaluation which is conducted by a Performance Evaluation Body according to the prescribed protocols. Therefore, the introduction of the PBC was not directly connected with 'difference of opinions.' Nevertheless, administrative procedures are available to resolve disputes regarding the judgment of building officials etc. or of the Performance Evaluation Bodies. Building Review Councils are set up by local governments to deal with investigation demands concerning actions or omissions taken by building officials etc. Investigation

demands regarding actions or omissions by Performance Evaluation Bodies may be made to the Minister under the Administrative Complaint Investigation Law.

THE NETHERLANDS

If it is not possible to validate a building construction according to the methods given by the Building Degree, an alternative solution might be applied. It has to be proved that such a solution meets the same levels of safety, health, functionality, energy economy and the environment. The municipality is the legal authority to approve such an alternative.

NEW ZEALAND

Disputes about compliance with the Code can be referred to the Department of Building and Housing for a "determination." A determination is binding between the parties to the dispute. A determination can confirm, reverse or modify a decision, make waivers or modifications to the Code, or make conditions that the decision maker may itself grant or impose. The Building Act requires a determination to be made within 60 working days and regulations prescribed a relatively low fee for this service making it a fast, efficient, accessible and cost effective method for dispute resolution. Determinations do not provide financial redress. If a person has suffered a loss as a result of non-compliance they have to use the court system to seek compensation, except if the issue relates to weather-tightness in which case they can refer their case to the weather-tight homes resolution service (WHRS). WHRS offers an adjudication and mediation resolution service for people wishing to claim for any remedy that could be claimed in a court of law in relation to weather-tightness. Claims are made on the grounds that the home must be or have been leaking (water is entering the house from outside) and where damage to the building has occurred as a result of the leaks.

NORWAY

Disputes will arise, and the mechanisms for resolving disputes are being scrutinized in new legislation. Ordinary appeals will be handled either by an appeal level within the local government or by the regional governor. These bodies will often consult the National Office of Building Technology and Administration. There may also be disputes between the accountable design or execution companies and the controlling companies. Such disputes may be referred to the local authority, which has the power to contract a third party control body. There has been a proposal for a national body or committee dealing with disputes, particularly with reference to performance based codes. The proposal was rejected on the grounds of the procedures being too time consuming and costly for the progress in a project, and the national legislative authorities were given the task of making the Building Code more precise for issues most likely to cause disputes.

SCOTLAND

The formal appeal process in the Scottish building standards system is to the Courts. Appeals may be made to the Sheriff Court under certain circumstances, such as when a verifier refuses to grant a building warrant or refuses to accept a completion certificate. An appeal must be made within 21 days of a decision being issued or of a notice being served. The Sheriff's decision on the matter is final and is binding on all parties.

Where the verifier and applicant are in genuine doubt as to whether a certain aspect of a building complies or not an application may be made to Scottish Ministers for a view. Building Standards Division acts on behalf of Ministers in this respect. The view of the Ministers is not binding on either party; however the verifier should have regard to it when determining the application.

SINGAPORE

Where any party feels aggrieved by the decision of the Commissioner of Building Control pertaining to applications for approvals or permit under the Building Control Act and Regulations, the legislation allows the aggrieved party to appeal to the Minister against the decision within 14 days after being served with the notice of the decision. The decision of the Minister in any appeal made under the Act or Regulations is final. The BCA does not deal with contractual disputes, which are normally resolved by the project parties, sometimes through arbitration bodies or the courts.

SPAIN

The Spanish legal system considers the building control as administrative acts, and thus the administrative legal system applies. That means that in case on dispute or denial of one building permit application, it has to be appealed to the same jurisdiction. In case that there is a negative reply the administrative way ends and starts the judiciary way in courts. For this kind of matters there are special courts on administrative matters which deal with the question. There is again a second possible appeal to a higher court in the Autonomous Community and the case can even be sent to the Supreme Court in Madrid.

SWEDEN

Disputes on technical requirements are solved in administrative courts. The municipal authorities are given ample power in the laws to decide on sanctions if building projects are deemed not to comply with the regulations. However this power seems to be used very sparingly. There are extremely few court cases where the technical requirements on buildings/works are the issue because of complaints about decisions from the building authorities. This is in total contrast to the situation concerning building permits. There are very many complaints about denials of building permits which are decisions mostly on compliance with the planning instruments, e.g. the permitted placing of a building or the size or height of it.

USA

This is an area that varies widely by jurisdiction and depends on a number of factors, including whether or not a jurisdiction is allowed by law to make decisions to allow variances from the code. This is particularly important for performance-based designs undertaken within the prescriptive code environment.

For example, in some jurisdictions, the authority can assess alternative designs and pass judgment on acceptability, where in others, the code official cannot take any action on alternate designs, as by law an appeal for variation from the code is required. In this case, a board of appeals will review the alternate design and make a determination. Aside for this specific type of legislative restriction, most jurisdictions have an appeals process of some sort for use when a resolution cannot be made with the building or fire official directly. In some cases these appeals boards are on a state level and in others they are at a local level.

Ultimately, if agreement cannot be reached within the building regulatory arena, appeals may be made within the judiciary system, with courts being the final arbiter. Here again, the reader is referred to the text, *Building Department Administration*, 3rd Edition (ICC, 2007), for an in-depth treatment of this topic.

B2.3.6 DUTY HOLDERS

AUSTRALIA

While the situation varies somewhat between the States and Territories, the responsibilities and duties of the different people involved in the building process is summarized as follows:

- Owners are generally responsible for ensuring the appropriate approvals are obtained before work commences (the initial building and any alterations/additions) and the work is completed in accordance with the approved documents and the relevant laws;
- Occupiers and tenants are generally responsible for ensuring the building and the safety systems are maintained to the level determined at the time of approval;
- Designers are responsible for ensuring the plans and specifications for the building work are suitably detailed to enable appropriate assessment by the council or private building certifier. Some designers (e.g.' structural, mechanical or fire engineers, or timber/steel truss designers) may be required to certify their designs;
- Builders may be required to certify they have undertaken the construction in accordance with the approved plans. Specialist trades (e.g., installers of waterproofing or termite protection systems) may be required to certify their component;
- Manufacturers or suppliers of materials or building components or systems may be required to provide documentation which shows the material or system complies with the relevant manufacturing or testing standard. Manufacturers can however apply to accredited certification bodies for a CodeMark certificate. Once obtained, this means the product or system must be accepted by the council or private building certifier;
- Verification checkers (i.e., council officers or private building certifiers) are usually responsible for ensuring the building work complies with the building regulations. They

can rely on certification by others involved in the process such as engineers, and specialist material/system installers;
- Insurers sometimes have additional requirements over and above the building regulations (e.g., may require fire sprinklers in some high hazard storage, or manufacturing situations);
- Standards organizations have a responsibility to ensure their standards are up to date and reflect contemporary building knowledge and research; and
- Regulators are responsible for ensuring the regulations meet government law making principles and the industry and community are consulted before changes are made. In the case of building regulations, the relevant principles include regulation as a last resort, performance-based, provide a positive cost benefit, permit competition, be internationally consistent, and expressed in plain language.

AUSTRIA

A building permit includes rights and responsibilities for the owner. All further parties involved (designers, contractors, specialists, as well as tenants or other occupiers have a contractual relationship with the owner. Their duties, right and responsibilities derive from these contracts, special legislation (e.g. law of tenancy) and civil law.

CANADA

Each party involved in construction has certain responsibilities:

- Owners have overall responsibility for their projects – for determining what will be built, for meeting laws and contractual obligations, and for choosing reputable designers and builders. Owners also have responsibility for inspecting and accepting completed work and for maintaining the safety features of their buildings throughout the building's life;
- Designers have responsibility for producing functional working drawings and specifications that comply both with applicable law and with owners' additional requirements, and may perform site review for the owner. Designers are also responsible for following provincial/territorial requirements governing which professionals are required for which projects. Professional architects or engineers must maintain required provincial/territorial licenses and professional liability insurance;
- General contractors have responsibility for the overall construction, including buying, scheduling, workmanship, and management of subcontractors and suppliers. Most subcontracts include a clause that work will conform to applicable codes. Most municipalities and/or utilities require contractors working on plumbing, electrical and gas installations to obtain special licenses, which usually include a mandatory requirement for qualified, licensed personnel. Most construction trades must also meet provincial/territorial training, certification, warranty and insurance requirements;
- Manufacturers have responsibility for supplying products that meet their advertised specifications and applicable standards. They usually establish quality control programs for their own facilities and for their authorized installers, offer limited warranties and are protected by proper insurance coverage;

- Standards development organizations have responsibility for producing reliable, useable voluntary standards that meet both the needs of the industry and of the regulatory authorities. They ensure due diligence through a broad consensus based process that includes extensive public review (www.scc.ca);
- Through the National Research Council of Canada (NRC) the Federal Government is responsible for the production of model code requirements, overseen by the Canadian Commission on Building and Fire Codes (CCBFC) (www.nationalcodes.ca);
- Provinces and territories have authority for enacting building regulation and have established mandatory building codes for all or most buildings. They also have authority for setting mandatory requirements for specific personnel (trade qualifications, professional qualifications, etc.) and for setting mandatory business requirements for certain types of firms, from trade contractor licensing, to professional self-regulation regimes for architects and engineers, to mandatory insured warranties in some provinces; and
- Municipalities in most areas have responsibility for examining plans and many inspect projects for general compliance with legal requirements. The municipal role in building is almost entirely derived from delegation of authority from the provinces and territories. The approach taken by provinces and territories has varied somewhat, but in general municipalities have responsibility for land use planning, enforcement of construction codes, maintenance and occupancy regulations for existing buildings, licensing of businesses and establishing limits on noise, hours of work, etc.

CHINA

All parties involved in the building process have certain responsibilities and duties, which can be summarized as follows:

- Owners have overall responsibility for their projects – for ensuring the appropriate approvals are obtained before work commences and the work is completed in accordance with the approved documents, the regulations and standards, for choosing reputable designers, builders and sometimes supervisors, and for inspecting and accepting completed work;
- Occupiers and tenants are generally responsible for ensuring the building and the safety systems are maintained to be in good condition and function well;
- Designers are responsible for ensuring the execution drawings for the building work are suitably detailed to enable appropriate approvals by the censorship and accurate understanding by the builders;
- Builders are responsible for ensuring construction site safety and construction quality are controlled in accordance with the regulations and standards, and for ensuring the timely rectification of defects during the warranty period;
- Supervisors may be required by owners to exercise supervision over the builder in regard to construction quality, construction scheduling and use of construction funds;
- Manufacturers or suppliers are responsible for supplying building materials or products and demonstrating their conformance to relevant standards with documentation; and
- Standards management organizations have responsibility for producing reliable, operable standards to reflect contemporary building technology, research and public opinion.

ENGLAND AND WALES

The duty to comply with the requirements of the Building Regulations is placed on the person carrying out the work. In most cases this would be the builder/installer. However, the duty also falls on the building owner. Prosecution for contraventions of the Building Regulations may be taken against the person carrying out the work (builder./installer), the building owner, or both. Notices requiring work to be brought up to the required standard or pulled down or removed may be served only on the building owner.

JAPAN

Responsibilities and duties of the people involved in the building process are summarized as follows:

- Building owners are required to:
  - Appoint a qualified Kenchikushi to design and 'superintendent' (monitor) the construction work;
  - Ensure the project goes through the building confirmation and inspection process; and
  - Maintain the building in a state complying with legal requirements after construction. (Owners of certain buildings are also required to have Kenchikushi or other qualified persons inspect the conditions of the buildings periodically.)
- Kenchikushi are required to design a building conforming to the BSL and regulations and to ensure that the construction work is executed in accordance with the design;
- Builders and specialists are required to execute the construction work in the manner of fairness and honesty according to the given contracts; and
- Building officials etc. are required to confirm that the building plans and construction works comply with the BSL and regulations. They have to confirm the conformity by themselves following the protocols issued by the MLIT. However, as stated in 2.2.3, alternative solutions need to obtain ministerial approval, for the contents of which building officials etc. are not responsible. Also, the structural calculation review bodies etc. review the structural calculation of certain buildings, for the result of which building officials etc. rely on.

Therefore, the building owner and delegated Kenchikushi are primarily responsible for the conformity of the BSL and regulations. Building officials etc. also assume responsibilities to certain extent (so do the Minister and Performance Evaluation Bodies for ministerial approval and the structural calculation review bodies etc. for structural review).

Housing sellers (they can be builders at times) are liable for major defects of new houses for over 10 years after the construction. To date, insurance has been voluntary. However, a new act was proclaimed in 2007 to establish a mandatory insurance/deposit system that covers the liability of housing sellers, which will be enforced on October 1, 2009.

THE NETHERLANDS

According to the Housing Act the owner is responsible for getting a permit before works start and is responsible to complete the work in accordance with this building permit. The owner is also responsible for the condition of the building constructions during its lifetime. To fulfill his public responsibility, the owner has to contract his architect, contractor, designer and other consultants in terms of private legislations, that these parties become responsible for their contribution.

NEW ZEALAND

Department of Building and Housing

The Building Act and associated Regulations are administered by the Department of Building and Housing (the Department). The Department's role in relation to compliance includes:

- Administering and reviewing the Code;
- producing and maintaining compliance documents that specify one, but not the only, means of complying with the Code;
- Making determinations, or technical rulings, on matters of doubt, or dispute relating to compliance with the Code or statutory decisions made by municipal authorities, for example the decision to issue or refuse building consents and code compliance certificates;
- Issuing warnings or bans about building methods or products which, if used, would result in building work failing to comply with the Code;
- Providing information, guidance, and advice on building controls to all sectors of the building industry, municipal authorities and consumers; and
- Monitoring and reporting on current and emerging trends to Ministers.

Building owners

Responsibilities of building owners include:

- Detailing work proposals on plans and specifications, including proposals for the inspection and routine maintenance of the specified systems for the purposes of the compliance schedule;
- Applying for building consents and project information memorandum;
- Constructing buildings in accordance with the 'approved plans and specifications';
- Applying for a code compliance certificate as soon as any work carried out under a building consent granted to them is completed;
- Maintaining buildings in a safe and sanitary manner;
- Ensuring any specified systems in their building are performing and will continue to perform to the performance standards; and
- Notifying the territorial authority if a change of use, extension of life, or subdivision is proposed.

Municipal and regional (local) authorities

Municipal and regional authorities are responsible for enforcing the Building Act and the Code in their areas of jurisdiction. Specifically this includes:

- Performing the functions of a building consent authority (as described below)
- Granting waivers or modifications of the Code;
- Issuing certificates of acceptance, certificates for public use, and certain notices provided for under the Building Act;
- Determining the extent to which buildings must comply with the Code if they are altered, or their use is changed or where there is a specified intended life change;
- Enforcing the provisions relating to annual Building Warrants of Fitness;
- Issuing certain notices provided for under the Building Act;
- Ensuring that dangerous, unsanitary and earthquake prone buildings and dams are identified and appropriate action taken to remove any danger or unsanitary condition;
- Amending compliance schedules;
- Considering and approving dam classifications and approving dam safety assurance programs; and
- Administering the Building Act, relating to dam classifications, dam safety assurance programs and dam compliance certificates.

Building consent authorities

Building consent authorities are primarily responsible for:

- Issuing building consents, notices to fix, code compliance certificates and compliance schedules; and
- Inspecting building work for which they granted a building consent.

Licensed building practitioners (LBPs)

Licensed building practitioners are responsible for:

- Carrying out or supervising restricted building work; and
- Notifying building consent authorities of breaches of building consents.

NORWAY

The building owner is regarded not to be a professional, and his responsibility is limited to not commencing the building work without a permit and to ensure that he contracts competent companies to undertake design, execution and the control roles. Professional practitioners with designed roles are the ones accountable to the Building Authorities. The professionals approved according to their role in the project are accountable to the local authority and have to comply with the requirements of the local authority. They shall have to comply with the building code and the spatial planning contingencies.

The approved applicant is responsible for the quality of the application for building permit and for ensuring that all parts of design and execution are covered by a control plan. He may also have the role of obtaining the completion certificate to be issued by the local

authority. This is a role most commonly taken on by an architect.

The approved design companies will be approved for different disciplines of design, i.e. architecture, structural design, fire design, services or more specialized fields. The approved design control company may be approved for different disciplines. The role may be taken on by the designer himself or be an independent entity. The approved executioner will be the contractor for the project as a whole or parts of it. It may also consist of several specialized contractors. The approved execution control company will generally cover the same scope as the execution as a whole or in parts. The role may be taken by the company accountable for the execution, the company accountable for the design, or independent companies. The local authority will issue the building permit, approve all accountable operators, will issue the completion certificate and is responsible for ensuring that control plans are adhered to, through surveillance of the project.

The National Office of Building Technology and Administration administers a central approval system for practitioners and perform random audits on the practitioners' quality systems. A central approval will assist the local authorities in assessing the suitability of the accountable practitioner according to the scope complexity of work.

SCOTLAND

Under the Scottish system the owner has final responsibility for the building owned, regardless of whether it is they or someone else, for example, their tenants, that have carried out the work. Where a building is sold any responsibilities conferred on the previous owner by the Building (Scotland) Act are transferred to the new owner. Although the owner has ultimate responsibility for any building he or she owns, where works are carried out without building warrant or in contravention of the warrant the following are deemed to have committed an offence:

1. any person carrying out the work;
2. any person on whose behalf the work is being carried out; and
3. the owner, if not 1 or 2 above

Local Authority Verifiers provide an independent check of applications for building warrant to construct or demolish buildings, to provide services, fittings or equipment in buildings or to convert buildings. They are also required to accept completion certificates after satisfying themselves that the work or conversion complies with the building warrant and relevant regulations.

The 32 local authorities in Scotland also have responsibility for enforcing the building legislation; regardless of who has undertaken the verification role should verifiers other than local authorities be appointed. Such enforcement issues cover dangerous and defective buildings and work carried out without or in contravention of building warrants, as well as enforcing continuing requirement and building regulation compliance notices.

An approved certifier of design may certify that certain parts of the building design comply with building regulations at the warrant application stage. Such certification must be accepted by the verifier and removes the onus for checking the areas covered from the

verifier. Similarly, a certificate issued by an approved certifier of construction may be submitted with the completion certificate. Again the certificate must be accepted by the verifier as confirming that the works as constructed comply with the building warrant and regulations.

The Building (Scotland) Act 2003 does not place any duty on the designer or the manufacturer or supplier of building material, however, other legislation, such as contractual law, consumer rights legislation, etc may be applicable.

SINGAPORE

The Building Control Act prescribes specific duties and responsibilities on various parties, including:

- Owners or developers of buildings or building works, who have duties to appoint the professionals and the builders to undertake their relevant roles prescribed by the Act;
- Qualified persons (registered professional engineers and registered architects), who have duties to undertake the design and supervision of relevant works under their charge;
- Accredited checkers and specialist accredited checkers, who have duties to check the structural and geotechnical design made by the relevant qualified persons;
- Licensed builders, who have duties to carry out the works in accordance to the requirements of the Act and Regulations and the approved plans;
- Site supervisors, who have duties in assisting the qualified person in the supervision of structural works; and
- Registered structural engineers, who have duties to undertake periodic structural inspections of existing buildings.

In the case of fire safety, Registered Inspectors who are licensed by the Fire Safety and Shelter Department have duties under the Fire Safety Act to inspect fire safety works in buildings to ascertain the degree of compliance of fire safety requirements.

SPAIN

The Building Act 1999 establishes the obligations of each and every one of the different agents participating in the building project, and the liability derived there from, considering the developer as the individual or legal entity taking the initiative for the entire process and the one obliged to guarantee the building against potential property damages. Under the heading of building activities, special mention is made of the main Contractor as well as the obligation to formalize any part of the works which may be subcontracted.

The Act also delimits the scope of the activity of the professionals, designer, the Works Director and the Director of Execution of the Works, clearly establishing the specific scope of their intervention based on their professional qualifications. The different agents will be personally and individually liable for property damages to the buildings caused by their own acts as well as by the acts of others for whom they are legally responsible under the Building Act. They will be jointly liable when the responsibility for the damages cannot be

attributed to any one individual or entity or when there is a concurrence of guilt but it is not possible to determine the influence which each agent involved may have had on the damage. The developer is regarded on the same level as the administrators of co-operatives or homeowners' association or similar associations which are becoming increasingly frequent in economic property management.

SWEDEN

The commissioner of a building project, normally the owner of the building, is responsible for the compliance with building regulations. As is described by Austria all further parties involved (designers, contractors, specialists, as well as tenants or other occupiers have a contractual relationship with the owner. Their duties, right and responsibilities derive from these contracts, special legislation (e.g. law of tenancy) and civil law.

USA

The primary responsibility for building and fire code compliance in the USA rests with the building owner. This means that the owner is responsible even though their tenants and or designers are the actual parties violating the code. However, due to the extremely litigious society in the USA, many people may be held responsible when an event such as a fire, major structural failure occurs or if major design and construction flaws are found within a building. Although the building owner is ultimately responsible, tenants, designers and contractors can be sued. In the case where a tenant turns off a sprinkler system and a fire destroys a building the building owner is held responsible for the code violation but can likely sue the tenant for negligence.

Building Official

In terms of the building official it is important to create a level of protection from liability in such a litigious society. Chapter 1 of the IBC provides the following language with the intent of protecting the building official from a consistent threat of a law suit. Without such protection it would be very difficult for a jurisdiction to function as they would not be able to effectively carry out their duties.

> *104.8 Liability. The building official, member of the board of appeals or employee charged with the enforcement of this code, while acting for the jurisdiction in good faith and without malice in the discharge of the duties required by this code or other pertinent law or ordinance, shall not thereby be rendered liable personally and is hereby relieved from personal liability for any damage accruing to persons or property as a result of any act or by reason of an act or omission in the discharge of official duties. Any suit instituted against an officer or employee because of an act performed by that officer or employee in the lawful discharge of duties and under the provisions of this code shall be defended by legal representative of the jurisdiction until the final termination of the proceedings. The building official or any subordinate shall not be liable for cost in any action, suit or proceeding that is instituted in pursuance of the provisions of this code.*

Generally Chapter 1 of the IBC and the administrative provisions of the ICCPC try to create a structure to clearly define the roles of those involved in the building regulatory system. Due to the complex issues related to a performance design the ICCPC provides much more detail on the role of the designers (design professional), building owner and authority. For instance the ICCPC establishes what is termed a principal design professional for designs requiring multiple designers.

> *103.3.1.1 Design professional. The owner shall have the responsibility of retaining and furnishing the services of a design professional, who shall be in responsible charge of preparing and coordinating a complete and comprehensive set of design documents and other services required to prepare reports and other documents in accordance with this code. If the services required by this section are not provided, the use of this code is prohibited.*
>
> *103.3.1.2 Principal design professional. When the project requires the services of multiple design professionals, a principal design professional shall be retained and furnished, who shall have the contractual responsibility and authority over all required design professional disciplines to prepare and coordinate a complete and comprehensive set of design documents for the project.*

B2.3.7 APPLICATION TO EXISTING BUILDINGS

This section reflects details from each IRCC member country regarding the applicability of building regulations to existing buildings. For additional information, Annex C reflects a summary of the 2007 IRCC survey regarding building regulation and existing buildings.

AUSTRALIA

The extent to which the BCA applies, and to which buildings and structures it applies to, is regulated via the Building Acts and Regulations of each of the eight Australian States and Territories. Therefore, the situation on how the BCA applies to existing buildings varies somewhat. Nevertheless, in general, the latest BCA applies where the use of an existing building changes (i.e., where the building's classification changes) and to new building work (extensions and major renovations) in existing buildings. Most States provide discretion for the approval body (the council or private building certifier) to allow minor alterations and additions to comply with previous editions of the BCA where there is no adverse impact on structural or fire safety. Some States have a rule that if more than 50% of the volume of the building is changed over a 3 year period, the whole building must be upgraded to the latest BCA.

If there is no building work carried out in existing buildings, the buildings are usually lawful if they continue to meet the code that applied when the building was constructed. However, some States require upgrading of specific existing buildings where there is perceived to be a need and usually as a result of a multiple death situation. For example, Victoria requires the installation of sprinklers in all existing aged care buildings, and Queensland requires

upgraded fire provisions in older hotels and backpacker accommodation. There is no separate code for existing buildings. However, some States have specific requirements to improve safety in existing buildings, even when no new work is carried out. Various Federal and State anti-discrimination laws could also apply to require improved access to existing buildings for people with disabilities. Only one level of performance is specified in the BCA. Therefore where building work in existing buildings warrants assessment against the latest BCA, the same level of performance applies for the existing building as for new buildings.

AUSTRIA

In general, for existing buildings, the owner is obliged to preserve through due maintenance the technical state of the building as at the time the building permit has been issued. Only in exceptional cases the owner may be forced to improve the properties of the building (e.g.: improvement of the energy performance in the case of major renovation). However, improvements may be necessary through other legislation, e.g. legislation on businesses and labour, civil law or even criminal law, especially with regard to dangers and threats (e.g. endangerment by negligence).

CANADA

The National Building Code of Canada as well as provincial building codes generally apply to the construction of new buildings and to the relocation of existing ones. They also apply when a building's use changes or when it is significantly renovated or altered. Some provincial codes have special provisions for upgrading of existing buildings at time of renovation, extension or change of use. In some jurisdictions special provisions have been introduced to mandate the upgrading of certain building features, such as those related to accessibility, energy efficiency and also for mandatory sprinkler protection of high-rise buildings or care establishments. These special provisions could allow some relaxation or alternative methods of applying current codes to construction work affecting existing buildings.

The National Fire Code of Canada as well as provincial fire codes generally apply to buildings and facilities already in use and regulate activities that create fire hazards. They contain requirements regarding the maintenance of fire safety equipment and egress facilities. They require fire safety plans in anticipation of emergencies. In sum, fire codes aim to reduce the likelihood of fires, particularly those that may present a hazard to the community, and to limit the potential damage caused by fires and by the handling and storage of hazardous materials. Municipal fire departments' primary role is emergency response. Municipal fire departments may also conduct inspections for fire code compliance. Usually, these inspections would concentrate on higher hazard occupancies. Fire department staff may also approve fire safety plans and proposed upgrades, and issue orders where required. Compliance with the NFC is the property owner's responsibility. Fines and penalties can be fairly significant. Inspections can be triggered by complaints, fires, random sampling, or a review of previous problems.

Some building owners and property managers enforce their own additional requirements for fire safety maintenance and emergency response plans in their own buildings. These additional requirements -- which go beyond the minimum level required by code -- will reflect personal differences in risk perception and risk tolerance. They may also reflect advice from insurance companies.

CHINA

In general, if existing buildings still meet the requirements of the regulations and standards which were in effect when the buildings were constructed, those buildings are usually lawful, i.e. there is no need for them to comply with the latest requirements, unless building work (conversion, alteration and extension) is carried out in them. However, in some cases, it would be made mandatory for large public buildings, especially governmental office buildings, to be altered in accordance with the latest requirements such as energy efficiency, accessibility, etc.

Without technical evaluation and design approval, it shall not be allowed to demolish/alter the structural elements or to add more floors. When an existing building reaches the end of the design working life, the owner shall entrust a reputable qualified institute to evaluate it and deal with it in accordance with the evaluation results. If the existing buildings need to still serve the function after they have suffered major disasters (earthquake, etc.), the evaluation and relevant treatments shall also be conducted.

When the work (conversion, alteration and extension) is undertaken to existing buildings, the requirements of energy efficiency, fire protection, and seismic resistance shall be considered simultaneously. In this case, some concessions or alternative methods of applying latest requirements to the building work could be allowed.

ENGLAND AND WALES

Building work is defined in the Building Regulations as:

- The erection or extension of a building. This would apply mainly to new buildings;
- The provision or extension of a controlled service or fitting. This applies equally to existing buildings;
- The material alteration of a building or a controlled service or fitting. This applies to existing buildings;
- Material change of use of an existing building;
- The insertion of cavity wall insulation in an existing building;
- The underpinning of an existing building;
- The renovation of certain thermal elements (roofs, walls, floors) of an existing building;
- A change of the energy status of an existing building; and
- Consequential improvements to the energy performance of buildings with a total useful floor area over 1000 m^2

In all the above cases a building includes a whole building or part of a building

JAPAN

In principle, it suffices if existing buildings met the requirements at the time of construction. Requirements set or revised after the constructions do not apply to them. However, they apply to the existing buildings at the time of addition, rebuilding, major repair/remodeling and alteration of use. In the 2004 revision of the BSL that was enforced in 2005, the application scope applied to addition etc. was relaxed to some extent. For instance, when an additional part of the building is attached to the existing part with expansion joints and stands separately in structure, the current structural requirements may not apply to the existing part under certain conditions. Also, at the time of addition etc, it became possible for the building owners to retrofit the existing part of the buildings step by step if the owner develops a certain rectification plans.

Improving the earthquake resistance of existing buildings is one of the major challenges in Japan, an earthquake-prone country. The MLIT and the local governments are encouraging people to retrofit their old buildings and housings by financial support including subsidy and tax reduction. As part of such measures, relaxed application of fire prevention requirements etc. apply to rectification of buildings aiming to improve earthquake resistance that satisfies certain conditions.

As stated in 2.2.6, under the BSL, building owners etc. must 'endeavor' to maintain the buildings in a state complying with legal requirements after construction. Regarding buildings used by many people and major building equipment like elevators (lifts), building owners etc. are required to have Kenchikushi or other qualified persons inspect the conditions of the buildings periodically and report the result to local governments. When an existing building is extremely dangerous to public safety or harmful to sanitation, local governments may issue recommendations or orders for the demolition or repair etc. to the owner, custodian or occupant, providing a reasonable grace period. Certain historic buildings are exempt from the provisions of the BSL and regulations.

NORWAY

Major work and extensions, structural alterations, facade changes, alterations to the use of the building and alterations leading to changes in the fire properties will generally be subject to regulations as for new buildings. If the work is so extensive that the whole structure is substantially renewed, an application for the building, as a whole shall be submitted.

As for maintenance and upkeep of existing buildings, the local authorities may issue a writ. This will normally be limited to structural defects. Fire issues will come under the jurisdiction of the fire authorities.

NEW ZEALAND

The Building Act 2004 has the following provisions dealing with existing buildings:

Alterations

When a building is altered it must:

- Comply as nearly as is reasonably practicable with the Code provisions for means of escape from fire and for certain public buildings, access and facilities for people with disabilities; and
- Continue to comply with the other provisions of the Code to at least the same extent as before the alteration.

Change of Use

A building that changes its use (defined in regulations) must comply as nearly as is reasonably practicable with every provision of the Code that relates to means of escape from fire, protection of other property, sanitary facilities, structural performance, fire-rating performance and for certain public buildings, access and facilities for people with disabilities. The building is to continue to comply with all other provisions of the Code to at least the same extent as before the change of use. Where the change is from a non-household use to a household use, then the new household is required to comply with the Code in every respect.

Extension of Life and Subdivision

An owner wishing to extend the life of a building (that has a specified intended life of less than 50 years) must comply with any conditions on the original building consent and the alteration provisions of the Act (as described above). An owner wishing to subdivide land in a manner that affects a building must comply with every provision of the Code that relates to means of escape from fire, and for certain public buildings, access and facilities for people with disabilities or protection of other property.

Inspection and Maintenance

All buildings with certain safety systems installed, known as 'specified systems', are subject to the building warrant of fitness regime. Owners of these buildings are required to submit a building warrant of fitness annually providing verification that the required inspection and maintenance has been carried out on the specified systems.

Dangerous and Unsanitary Buildings

If a municipal authority considers a building to be dangerous, unsanitary or earthquake-prone they may:

- Put up a hoarding or fence to prevent people approaching the building;
- Attach a notice to the building warning people not to approach the building; and
- Give a written notice requiring work to be carried out on the building to remove or reduce the danger or prevent the building from remaining unsanitary.

THE NETHERLANDS

According the Housing Act the building owner is responsible for the condition of the construction. The municipalities have the responsibility to look after the condition of existing construction works. This is mostly done by their department of local building control, which

checks whether the building stock complies with the requirements for existing buildings as given by the Building Degree. Ordinarily these inspections are carried out as a result of complaints by tenants. Active controls are only executed in case of urban renewal or known degradations effects for works from a certain building period.

The Dutch building regulations gives separate requirements for existing buildings. The level of requirements is mostly lower than those for new buildings, but the same performance-based system with functional and subsequent performance requirements and validation methods is used.

SCOTLAND

As a generalization, the building regulations do not apply retrospectively to existing buildings in Scotland. There are, however, four exceptions to this.

1. Alterations and extensions to existing buildings must not cause the building to fail to comply to a greater degree than it did prior to the alterations or extension being formed. Where proposed works adversely affect the existing buildings, for example, lengthening travel distances to exits, the existing building should be altered to comply with current requirements.

2. If a proposed change in the use of an existing building is one of ten prescribed "conversions", then the requirements of the building regulations apply to the building as a whole. As few existing buildings can reasonably be altered to meet all aspects of current standards, the regulations list those standards that should be met in full and those that are required to be met as far as is reasonably practicable.

3. Scottish Ministers have the power to impose "continuing requirements" on the owners existing buildings. Building regulations state which provisions such a requirement may apply to; at present only regulation 17, covering the maintenance of certain air conditioning systems, is so designated. The local authorities are responsible for enforcing continuing requirement enforcement orders.

4. Scottish Ministers may also determine that certain types of existing buildings are required to comply with one or more regulations. They will then direct all or some local authorities to ensure that the owners of these buildings carry out the necessary work. This power is only expected to be used if particular problems become evident.

Where improvement work to an existing building is necessary due to other legislation, for example, fire safety legislation, a building warrant may be required. Such an application would be treated as the first exception above. A supplementary guidance document having the same status as the technical handbooks has also been developed with Historic Scotland for use when existing historic or traditional buildings are being altered or extended.

SPAIN

The Spanish Building Code applies for new private or public buildings that require a building permit. It also applies to any extension, reform, alteration or rehabilitation realized in

existing buildings provided the works are compatible with the nature of the intervention, and, if applicable, with the protection level the relevant buildings might have. This possible incompatibility has to be justified in the project, and if any, be compensated with alternative measures, technical and economically feasible.

Some requirements, such as the set in the energy part of the code are to be applied compulsorily, depending of the size of the building >1000m^2) and a certain percentage of the façade to be renewed. This is due to application of the European Directive on Energy Performance of Buildings (EPBD). And finally, the fire part of the code is to be applied in certain changes of use regardless if works are planned or not. Therefore if no building permit is needed for a certain change of use another type of local permission called the 'opening permit' ("licencia de apertura") is needed to legalize the new premises with the new use, and then the code has to be fulfilled.

SINGAPORE

Except for minor building works (which are exempted and listed in a Schedule in the Building Control Regulations), the Building Control Act and Regulations generally apply to all new buildings as well as works connected with or carried out for existing buildings, including:

- the alteration, addition or repair of an existing building; and
- the provision, extension or alteration of any air-conditioning service or ventilating system in or in connection with an existing building.

For existing buildings, there are also provisions for mandatory periodic structural inspection to ensure that the buildings are properly maintained and remain fit for occupation throughout its intended life span. Building owners are required to appoint registered structural engineers to make these inspections and to recommend, where required, rectifications and measures to ensure the building's safety. Owners are required to carry out the works in such recommendations.

In cases where an existing building is deemed to be dangerous by the Commissioner of Building Control, there are provisions granting powers to the Commissioner to take a number of prescribed actions to obviate the danger, including directing or carrying out repairs, demolition or closure of the building.

The Act also has provisions that require building owners to ensure that prescribed physical features of an existing building continue to satisfy the performance requirements. Where, in the opinion of the Commissioner of Building Control, any physical feature of a building has been removed, altered or obstructed so as to cease to satisfy the relevant performance requirement, the Commissioner of Building Control may require such repairs, work or alteration to the physical feature or the building or other remedial action as he thinks fit to be carried out to reinstate the physical feature so as to satisfy the relevant performance requirement. The physical features that are currently prescribed for continued compliance are those related to accessibility for the "person with disabilities", which is defined to mean

an individual who has a physical impairment, either of hearing or sight, or an impairment which limits his ability to walk, or which restricts him to using a wheelchair.

As Singapore is a densely populated city state with high-rise living, there is a strong need for public safety from falling external features in a building. The Act provides power for the Minister to prescribe, after publishing in the Gazette, the duties and responsibilities of owners or occupiers to carry out retrofitting of an exterior feature which is at risk in existing buildings. So far, orders had been issued for owners or occupiers to retrofit air-conditioning units which are mounted on or project from the external parts of existing buildings with structural supporting system to support the air-conditioning units, and casement windows which are installed on or form part of the exterior of any residential building, are opening outwards, and are fitted using aluminum rivets.

SWEDEN

The provisions of the building regulations apply to new as well as existing buildings and civil engineering works when altered in any way. The owner of a building is also obliged to preserve through due maintenance the technical state of the building, in principal as at the time when it was built or altered in any way. Installations for e.g. fire safety, lifts, ventilation must be kept up to the standard as when installed. The technical requirements must be fulfilled when existing buildings or civil engineering works are altered but with due consideration taken of the legal requirements of cautiousness intended to preserve the characteristics of a building, as well as keeping any historical, cultural and *in situ* values. Furthermore when altering an existing building in applying the technical requirements, consideration shall be given to the extent of the alteration and the capacity of the building. Thus, when buildings are altered there are many obligatory considerations to be made in an individual project apart from those when starting anew. Because of these difficulties to give detailed and general regulations for the alteration of existing buildings the detailed mandatory Building Regulations given by Boverket (BFS 1993:57) only apply to extensions of existing buildings. However there are guidelines from Boverket on how to act when altering buildings. And the Structural Design Regulations (BFS 1993:58) are applicable to new buildings, to extensions and to added (structural) parts. Correspondingly they are also applicable to civil engineering works apart from tunnels or rooms in rock.

USA

Approaches to existing buildings vary widely throughout the country. There are various factors affecting this including the age of the building stock, historical significance of the building stock, the political atmosphere, the economic atmosphere and the types of hazards threatening the building stock such as seismic risks. Also, in some cases a large loss drive requirements for existing buildings. A good example of such retroactive requirements comes from the Station Nightclub Fire in 2003 in West Warwick, RI where 100 people died as a result of pyrotechnics being lit in an unsprinklered building with a multitude of non conforming issues. From that incident several states in the area enacted state laws requiring sprinklers in existing nightclubs. Generally, most states adopt provisions into their

code stating that existing buildings may remain as long as they continue to comply with the code in which they were originally constructed unless they pose a particular hazard.

Codes such as fire codes and property maintenance codes will apply when adopted in certain aspects of the building such as smoke alarms in existing residences and the general management of aspects of contents such as combustible materials and hazardous materials. Retroactive requirements for aspects such as sprinklers when a building has not made any changes are rare. Such provisions are generally met with extensive political roadblocks unless they are a result of a fire such as the Station Nightclub. If an existing building is renovated or additions are being made then some requirements will generally apply to the building. The type of provisions vary but the primary areas where requirements will come from include:

- Chapter 34 of the IBC;
- International Existing Building Code; and
- State specific requirements – rehabilitation codes.

Chapter 34 of the IBC unless amended by the state or local government will be considered part of the building regulations. Many States such as Massachusetts and New Jersey treat existing buildings differently through amended versions of Chapter 34 or in the case of New Jersey through their Rehabilitation Subcode. Chapter 34 of the IBC Provides two approaches. The first provides basic administrative and prescriptive requirements for alterations, additions, repairs, change of occupancy and historic buildings. These provisions tend to be fairly restrictive for any alterations in a building as compared to documents such as the IEBC that provide more flexibility. There are also requirements for accessibility. The other approach is a scoring method that ranks the building and determines if and where improvements need to be made.

The IEBC is a separate code focused primarily on existing buildings and providing flexibility when addressing existing building stock undergoing repairs, renovations, additions and change of occupancy. The code provides three methods. Two of these methods come directly from Chapter 34 of the IBC. The other method is termed the “work area method” which basically provides comprehensive set of requirements for different levels of work being conducted in a building.

B2.3.8 SCOPE AND CONTENT OF THE BUILDING REGULATIONS

AUSTRALIA

The BCA contains technical provisions for the design and construction of buildings and other structures, covering such matters as structural safety (including consideration of wind, earthquake, snow loads and flood), fire safety (including fire resistance, early warning and fire suppression systems, and protection from bushfires), access and egress (including access for people with disabilities), swimming pool safety, services and equipment, energy efficiency, as well as certain aspects of health and amenity such as provision of sanitary

facilities, waterproofing, ceiling heights, sound insulation, light and ventilation. Some State and Territory building regulations cover matters additional to those addressed in the BCA such as water efficiency issues, and those issues resulting from consolidating building related requirements from other State laws such as those relating to specialist health, occupation, or accommodation uses.

AUSTRIA

Building regulations in Austria cover the field of the six “essential requirements” (mechanical strength and stability, safety in case of fire, hygiene, health and the environment, safety in use, protection against noise, energy economy and heat retention) as well as access for all. Building regulations do not cover electrical installations, which are regulated by a federal law. Building regulations apply to all kinds of construction works (buildings and civil engineering works), except those which are covered by special federal law (e.g.: railways, motorways, waterways, avalanche barriers, military buildings) or by special provincial law (e.g. provincial roads, secondary roads and other public roads).

CANADA

The National Building Code of Canada (NBC) as well as provincial building codes are generally concerned with health (indoor conditions, sanitation, noise, etc.) and safety (fire, structural, in use, etc.) of persons in buildings, accessibility to and inside buildings for persons with a physical disability and the protection of buildings from fire or structural damage. The National Plumbing Code (NPC) as well as provincial plumbing codes are generally concerned with health and safety of persons in buildings, and the protection of buildings from water and sewage damage. Some provincial building codes also address emerging objectives such as energy and water-use efficiency. There is a growing interest in Canada for addressing such objectives in the model national codes (NBC and NPC). Some provincial codes also cover farm buildings, and facilities that are auxiliary to buildings such as swimming pools, on-site septic systems, etc.

National and provincial codes generally contain minimum requirements intended to provide a level of performance that is deemed to be the minimum acceptable to society as a whole in those areas (health, safety, etc.) where there is a consensus on the need to regulate. This notion of minimum performance is recognition that regulation is only one of the available mechanisms to provide buildings that meet clients and societal expectations in a timely and cost-effective fashion. Considerations of durability, aesthetics, convenience, spaciousness, market value are generally not considered appropriate for minimum codes and regulations. Many emerging societal expectations related to sustainability of construction are generally addressed by use of market-driven instruments, education and incentive programs rather than through regulations.

CHINA

The mandatory requirements in the building standards contain technical provisions for planning, design, construction, acceptance, use and maintenance of buildings and other

structures, aiming at ensuring safety, health, resources efficiency, environmental protection and public interest. The technical provisions are generally concerned with structural safety (including consideration of wind, earthquake, snow loads and flood), fire safety (including fire resistance, early warning and fire suppression systems), safety in use, services and facilities, health and amenity (including sunshine, lighting, sound insulation, ventilation, damp proofing, indoor air quality and indoor air pollutants control), accessibility (including access to and in buildings), energy efficiency, water efficiency, land saving as well as environmental protection. Some mandatory requirements in local standards cover more detailed requirements (such as energy efficiency, water efficiency, etc.) than those in the national standards, considering specific climatic or geological reasons. There are also some additional issues, such as protection against termites, etc., addressed as mandatory requirements in local standards.

ENGLAND AND WALES

Building Regulations may be made for the purposes of:

- Securing the health, safety, welfare and convenience of persons in or about buildings;
- Furthering the conservation of fuel and power;
- Preventing waste, undue consumption, misuse or contamination of water;
- Furthering the protection or enhancement of the environment;
- Facilitating sustainable development; and
- Furthering the prevention and detection of crime.

Building regulations made for the above purposes may cover the design and construction of buildings, the demolition of buildings or the services, fittings and equipment provided in or in connection with buildings.

In general, the Building Regulations set out both the technical standards to be achieved and the procedures to be followed in achieving those standards.

JAPAN

The purpose of the BSL is to safeguard the life, health and property of people by providing minimum standards concerning the site, construction, equipment and use of buildings, and thereby to contribute to the furtherance of the public welfare (Article 1 of the BSL). For this purpose, the BSL and regulations comprises:

- General provisions (administrative, miscellaneous and penal provisions);
- Building codes provisions (structural, fire and hygienic safety); and
- Planning codes provisions (relation between site and road, land use, building height-bulk-shape control, restrictions in fire protection district).

There are many other regulations concerning building safety and hygiene such as the Fire Service Law and the Water Works Law. Basically, the scope of technical requirements in these laws and the BSL and regulations are delineated. The relevant requirements concerning building construction in these laws are referred in the BSL to ensure consistency.

The BSL and regulation are also applied to certain structures including chimney, steel tower, windmill, amusement facility (roller coaster etc.) and retaining wall.

THE NETHERLANDS

The regulations of the Housing Act deal with the whole area of housing, from subsidies to requirements, and from building permit procedures to regulations for existing buildings. The Housing Act refers to the Building Degree for the technical requirements. Additional regulations are given in the General Administrative Order Regulations. One is dealing with the exemptions (permit free constructions) and the construction that qualify for a 'light' permit procedure. The other is dealing with the submittal demands during the process of getting a permit.

The Building Decree concerns safety (e.g. mechanical strength, fire safety, user safety like requirements for stairs, availability of emergency appliances), health (e.g. ventilation, sound insulation), utility (e.g. accessibility for disabled people, habitable space toilet compartment, communal store for domestic waste), energy-saving (e.g. thermal insulation, energy performance, air tightness) and sustainability (still an empty chapter). Functional units for both new and existing structures, for which specific requirements must be met, are residential function, assembly function, detention function, health care function, industrial function, office function, education function, sports function, retail function, and other functional unit.

NEW ZEALAND

Safeguarding people from injury or illness and protecting other buildings and property are common objectives throughout the Code. The Code is divided into seven main sections.

Stability - includes structural provisions to safeguard people from injury and loss of amenity, and protect other property from physical damage due to structural failure. It also includes durability provisions to ensure that a building will remain durable for sufficient time so as to allow for the other objectives of the Code to be met.

Fire safety - These provisions intend to ensure the likelihood of fire from a fixed combustion appliance is reduced, there is adequate time and protection for people to escape a building and carry out fire rescue operations, there is adequate protection of other property, and there is reduction of significant quantities of hazardous substances released into the environment. A building is required to remain structurally stable to ensure the above provisions are satisfied.

Access - covers access routes into and within buildings and safety around the use of mechanical installations such as lifts, escalators and moving walks.

Moisture - Requirements range from the provision of sufficient disposal of surface water to providing adequate protection from external moisture entering the building and accumulation of internal moisture that may cause dampness related contaminants.

Safety of users – covers eight topics relating to the use and construction of buildings including hazardous agents on a building site, building materials, and hazardous substances and processes. Other clauses intend to safeguard people from injury or illness due to falling, inadequate lighting, lack of awareness of an emergency, and inadequate identification of escape routes, hazards, directions, or accessible routes for people with disabilities.

Services and facilities – covers fifteen topics including spaces and facilities for personal hygiene, laundering, and food preparation and prevention of contamination. They also seek to ensure buildings have appropriate ventilation, interior environments, noise control, natural and artificial light, electricity and gas, piped services, water supplies, and foul water and solid waste control.

Energy efficiency - covers efficiency in modifying temperature or humidity, providing hot water and providing artificial lighting.

NORWAY

The national building regulations will cover all aspects of buildings and also civil engineering works, unless requirements for such works is covered by other national authorities i.e. national roads, railways and electricity plants and grid.

It contains all aspects of safety including siting and dangers of natural disasters and health. In addition to the "6 European essential requirements", all aspects pertaining to universal design and equal rights in buildings are contained in the act and regulations. Furthermore the regulations have requirements relating to sustainability and environmental aspects as well as energy consumption. All installations excluding electrical installations, but including lifts are contained. Requirements to public water, drainage and sewer pipes are also included.

The regulations make reference to national standards, which will satisfy the requirements.

SCOTLAND

The purpose of the Scottish building standards system is to protect the public interest. It is intended to ensure that building work on both new and existing buildings results in buildings that meet reasonable standards and:

- Secure the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings;
- Further the conservation of fuel and power; and
- Further the achievement of sustainable development.

The building regulations introduce over 60 functional standards that are split into six sections covering:

Structure Preventing collapse or deformation of the building and disproportionate collapse;

Fire Essentially from a life safety perspective, considering means of escape, separation, fire spread, fire service requirements;

Environment Considers harmful substances in the site, flooding, drainage (including final disposal from site), weather-proofing, sanitary facilities, ventilation, natural lighting, combustion appliances and fuel oil storage;

Safety Covers access to and within buildings for all people, stairs, electrical works, limiting dangers from glazing and LPG gas storage;

Noise Covers the design of walls and floors of dwellings to resist airborne and impact sound transmission; and

Energy Considers methods of reducing energy use in buildings, covering the heated envelope, heating system, artificial lighting, air conditioning, commissioning services and energy performance certificates.

Two Technical Handbooks, one each for Domestic and Non-domestic buildings, are produced in hard copy and electronic formats and contain the functional standards and technical guidance documents.

The building regulations apply to all buildings, including Crown. Certain small or low risk buildings and buildings controlled by other legislation, for example, the Nuclear Installations Act 1965 are excluded. The term “building” is defined within the Act and essentially means any structure or erection, except civil engineering works, such as public or private roads, railway lines, etc.

SINGAPORE

The Building Control Act and Regulations contains technical provisions for the design and construction of buildings and building works in the following areas:

- structural safety, including structural provisions to safeguard people from injuries and loss of amenity, protect other properties from physical damage due to structural failure and ensure durability;
- access and egress, including provisions for people with disabilities;
- amenities, including ceiling heights, safety barriers to prevent falling from height, light and ventilation, lifts;
- energy efficiency, such as envelope thermal performance for buildings; and
- sustainability, with provisions to require new buildings and those undergoing major additions, extensions or retrofitting to adopt environmental friendliness measures. Such buildings are required to achieve a minimum environmental sustainability standard that is equivalent to the Green Mark Certified Level. The Green Mark is a “green” building rating system developed by the Building and Construction Authority to evaluate a building for its environmental impact and performance.

Other aspects of development that are considered under the building control system in some countries such as fire safety, workers' health and safety, environmental issues (noise, drainage, sewerage, pollution) and services (electricity, water, gas and other piped services) are also regulated, but by separate legislations which are administered by other government agencies. They are:

- Fire Safety and Civil Defence Shelters, which are regulated by the Fire Safety & Shelter Department (FSSD);
- Sewerage, Drainage, Environmental Health and Pollution Control, which are regulated by the Central Building Plan Unit (CBPU) of the Ministry of the Environment and Water Resources;
- Cutting and planting of trees and carrying out of works in gazetted Tree Conservation Areas, which is regulated by the National Parks Board (NParks);
- Matters involving roads, railway protection and vehicle parking, which is regulated by the Land Transport Authority (LTA);
- Matters involving kindergarten, private school or institution of learning, which require clearances from the Ministry of Education (MOE); and
- Matters involving construction of any sea wall, river wall or revetment along the bank of any port, river or channel, or erection of any permanent building or structure within 15 m of the foreshore or of any such bank, which is regulated by the Urban Redevelopment Authority (URA).

SPAIN

The Building Act, and therefore the Building Code, applies to building processes, understood as the actions and results of constructing a permanent public or private building, the principal use of which falls into one of the following categories:

a) Administrative, health, religious, residential, educational and cultural buildings;

b) Aeronautics, agriculture and livestock; energy; hydraulics; mining; telecommunications (referring to the telecommunications engineering); land, ocean, fluvial and air transport; forestry; industry; naval; plumbing and hygiene engineering; accessories to engineering works and the operation thereof; and

c) All other buildings whose uses are not specifically indicated in the preceding groups.

The Code is divided into two parts, both regulatory. The first one contains general provisions (scope, structure, classification of occupancies, etc.) as well as the objectives that buildings must meet in order to fulfill the basic building requirements established in the Building Act, that make them fit for the use they were meant to have, in accordance with society's needs. Also, the Basic Requirements that building must meet in order to achieve these objectives are prescribed. These basic requirements are the specific conditions to be accomplished by

buildings in their planning, as well as in their constructive systems and the products they are made of.

The second part contains Basic Documents (BD), guaranteeing, through its proper use, the fulfillment of the Basic Requirements. These Basic Documents contain procedures, technical rules and examples of different solutions, in order to decide whether one particular building reaches the established quality standards.

Currently the Code contains the following Basic Documents:

A) Basic Safety Documents
- DB-SE. Structural Safety.
- DB-SE-AE. Building Actions
- DB-SE-C. Foundations.
- DB-SE-A. Steel Structures.
- DB-SE-F. Masonry Structures.
- DB-SE-M Timber Structures.
- DB-SI. Safety in case of fire(to be completed in 2009 with new accessibility requirements)
- DB-SU. Safety of use (to be completed in 2009 with a new accessibility requirements)

B) Basic Habitability Documents
- DB-HS. Healthiness (Health, Hygiene and Environment)
- DB-HR. Noise Protection
- DB-HE. Energy Saving

The said Basic Documents define the basic requirements and their quantification, according to the scientific and technical progress in the building sector. They establish, on the one hand, the levels or the threshold values that the performance of the buildings or their parts should meet according to the basic requirements, and, on the other hand, the procedures by which the above requirements are proven. These procedures are materialized by practice-proven verification methods or solutions.

The new Code represents the revision, updating and completion of the current requirements previously established by the basic regulations existing since 1977. On some subjects until now non regulated, such as foundations, timber structures, non-brick masonry, indoor air quality, waste disposal, use of renewal energies or lighting systems efficiency, the Code has also included new requirements.

SWEDEN

The technical requirements on buildings and other civil engineering works as presented in the *Act on Technical Requirements for Construction Works, etc. (SFS 1994:847),* generally follow the essential requirements as mentioned in the Annex 1 of the Constructions Products Directive (89/106/EEC). Specifically, the Technical Requirements note that constructions which are erected or altered shall, on the assumption of normal maintenance, during an economically reasonable time of use comply with essential technical requirements concerning:

(1) Load bearing capacity, stability and durability;
(2) Safety in case of fire;
(3) Precautions with regard to hygiene, health and environment;
(4) Safety in use;
(5) Protection against noise;
(6) Energy economy and thermal insulation;
(7) Suitability for the intended purpose;
(8) Accessibility and fitness for use with regard to persons with limited mobility or orientation capacity; and
(9) Economical management of water and waste.

The regulations require that constructions shall be maintained so as to essentially preserve the technical requirements, with facilities intended to meet the requirements kept in proper operating condition. The Government has given further provisions in the *Ordinance on Technical Requirements for Construction Works* (SFS 1994:1215).

More detailed mandatory provisions and general recommendations for building construction, the *Building Regulations* (BFS 1993:57), are issued by the Swedish Board of Housing, Building and Planning. Furthermore, there are mandatory provisions and general recommendations on the load-bearing capacity, stability and durability of load-bearing structures in the Structural Design Rules (BFS 1993:58) as well as regulations for lifts, escalators, passenger conveyors and mechanically operated doors and performance inspections of ventilation systems (the latter in the Ordinance (SFS 1991:1273)

USA

Building codes in the USA, like in any other country, continue to evolve. The earliest building codes focused only upon property protection as it pertained to conflagrations. As time progressed with several large life loss events life safety began to appear in regulations. Additionally, after several major earthquakes and general structural losses seismic and structural provisions appeared. Much of the early building regulations were initiated and heavily supported by the insurance industry due to large financial losses they were experiencing. In current times most people do not see building regulations linked all that closely with the insurance industry, however, the insurance industry does depend heavily on building codes being adopted and enforced. In some cases insurance companies will enforce stricter requirements based upon risk evaluations of certain activities of types of structures. The scopes of building and fire codes have become an expectation of society and are not limited to addressing hazards such as fires and earthquakes.

Over the years public health issues such as plumbing and interior environment issues such as natural lighting and heating have also become part of the scope of the codes. In more recent years civil liberty issues such as accessibility have become part of the scope of the codes. In the case of accessibility it was the American with Disabilities Act (http://www.usdoj.gov/crt/ada/adahom1.htm) that brought about the need for these provisions. The act did not come with compliance provisions initially and the model code organizations at the time felt that since the codes have such an effect on the layout and design of buildings that accessibility needed to be included in order to avoid conflict with

federal law. It was not required of the model codes to provide these requirements as such organizations are not a government entity. Currently there are several federal level requirements/laws that affect accessibility in buildings. ICC is constantly striving to be consistent with those agencies. It should also be noted that the Fair Housing Act which was enacted in 1988 has requirements for accessibility in new multifamily housing. The ICC codes have been reviewed and accepted as what is termed “safe harbor” meaning that the provisions are deemed to comply with the Fair Housing Act.

Another subject that has become increasingly important over the years is energy efficiency. The ICC has published such a code titled the International Energy Efficiency Code for some time and the primary premise of the document historically has been on conserving energy uses in a building with the overall goal of conserving fossil fuels. The focus had not been on more global issues such as sustainability, though energy efficiency is a subset. It should be noted that there may be other agencies within the state or the federal government such as the Environmental Protection Agency that could be driving these issues. Of course in more recent years energy efficiency has become more important and is evolving into the wider issues of sustainability or “going green” with the greater goal of saving the environment for future generations. This currently is being addressed differently in practically every state and even in many local jurisdictions. As noted the ICC has published a model energy code (International Energy Efficiency Code) focused upon energy efficiency. The ICC has only more recently been pursuing the concept of green buildings and sustainability as a whole. The organization has made it a high priority as society seems to be evolving to expect such issues to be addressed in the regulatory realm versus depending upon the marketplace.

Issues like sustainability are complicated and since there is not an immediate life safety threat associated with such provisions it becomes very difficult as to how and to what extent the topic should be addressed. In either case the ICC has made “going green” a high priority with involvement with groups such as the National Association of Home Builders to write a new standard for houses in this regard. There are also several proposals on the issue of sustainability coming through the code change process from a variety of stakeholders. Some of these proposals are in part to adopt green building standards such as the draft Standard ASHRAE 189.1 and requiring reductions in energy consumption.

There are ongoing discussions and debates as to the types of hazards to be addressed by building codes after 9/11. Although most feel it is unrealistic to design buildings to withstand threats posed by terrorists or even for arson there has still been many proposals trying to focus on certain aspects of the building that may reduce the impact of such threats. For instance the 2007 Supplement to the IBC requires a third stair in high-rise buildings more than 420 feet in building height to facilitate faster egress. Also exit enclosures in high rise buildings are required to mark the exit path such as marking the stair treads. Many of these proposals were a result of the recommendations by NIST based upon the study of the World Trade Center.

B2.3.9 THE DEFINITION OF PUBLIC INTEREST

AUSTRALIA

The Australian building regulations have traditionally been concerned with life safety of building occupants and preventing damage to neighboring buildings. The regulations have not included property protection as a primary objective. However, new or extended objectives are being added to building regulations as a result of changing societal expectations and the acknowledgement by governments that the BCA is a suitable vehicle for introducing building requirements resulting from new policies (e.g., reducing greenhouse gas emissions by efficiently using energy, and improving access to buildings for people with disabilities). It is anticipated future changes to the BCA may occur in relation to increasing the stringency of greenhouse reduction measures, introducing water efficiency measures, improving access for people with disabilities, and reducing the risk to people and buildings as a result of large scale disasters such as bushfires, cyclones, and the impacts of climate change.

AUSTRIA

Generally speaking, building regulations in Austria are concerned with protecting the public interest with regard to the health, safety and welfare of people in and around buildings, but building regulations do not take into account material assets. Furthermore building regulations protect neighbours (individual persons) in their justified rights.

CANADA

Canada has a mixed economy, with a functioning competitive market within a varied regulatory structure. Beyond regulated minimum requirements, sellers compete on the basis of how well they can satisfy their buyers' needs. Industry, government and consumers all choose what level of risk to accept -- whether actively or by default. They perform or neglect to perform research and due diligence, accept contract terms, and take out one or more of the available insurance-type policies, choosing deductibles and limits. Codes and compliance systems are expected to help to reduce the fundamental risks in the building itself. Other laws and regulations help to avoid fraud, uphold written agreements, control the use of market or bureaucratic power, protect property rights, etc. and maintain disincentives and/or penalties for non-compliance. Beyond that, lawyers are available to review contract terms, third party designers or inspectors are available to review work, some information sources are available on companies, products, etc. plus there are a number of insurance products and (for new homes) third-party warranty providers. Some provinces also establish mandatory warranty programs, and controls on firms.

All provinces and territories have consumer protection legislation requiring certain businesses to be licensed as a vendor or direct seller. Acts typically establish system of registration, including requirements, registrars, fees, surety, enforcement, penalties and appeals. All provinces and territories set up self-regulating bodies for architects and engineers and have different requirements for certification of trades. Where certification is

compulsory, a person cannot practice that trade in the province/territory without having met the applicable qualifications. At least 3 provincial governments have established different systems requiring new homes to be covered by third party or insured warranties. The Acts establish coverage, application, enforcement, penalties and appeals, plus criteria and provincial review of providers. In other provinces and territories, private sector organizations offer insured home warranties on an optional basis.

CHINA

The Chinese building regulations and standards have been traditionally concerned with life safety of building occupants through ensuring the quality and safety of the buildings. The building standards are mostly prescriptive, with the requirements of how to design and construct the buildings. At the same time, the building standards have also included cost-effectiveness as a primary objective with the limit of economical development level.

In terms of society as a whole, the regulations and standards can be used as a suitable instrument to reduce the amount of losses in events such as hurricanes, earthquakes and fires. Furthermore, with the changing of societal expectations and the level of technology and economy, new or extended objectives are being added to the regulations and standards. This can be seen in inclusion of regulations and standards to reduce the CO_2 emissions by efficiently using energy and to improve the accessibility to and in buildings for disabled and aged persons. It can be anticipated that the regulations and standards will introduce more stringent requirements of energy efficiency, water efficiency, and furthermore, sustainable development.

It must be noted that the changes shall be made to the regulations and standards in relation to reducing the risk to people and buildings as a result of large scale disasters such as earthquakes, especially after the major earthquake measuring 8.0 on the Richter scale that jolted Wenchuan County of southwest China's Sichuan Province at 2:28 p.m. on May 12, 2008. In fact, the regulations and standards related to seismic fortification have already been revised or are under revision in China.

ENGLAND AND WALES

The purposes from which building regulations may be made are set out above in the section on the scope of the building regulations. There is a public interest in making sure that they protect health, safety, welfare and convenience (including provision of access for those who might have disabilities which restrict their use of buildings). There is also a public interest in setting energy efficiency standards for buildings to help reduce the emission of greenhouse gases.

JAPAN

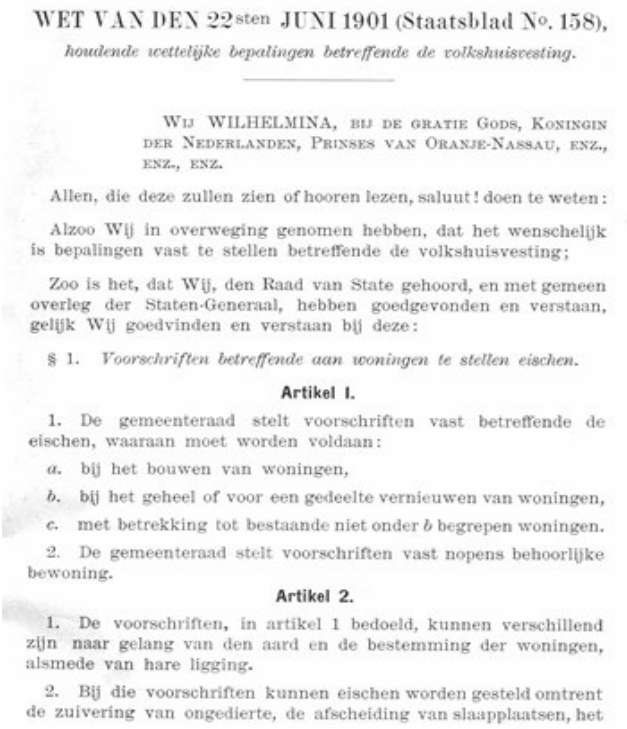
The purpose of the BSL is to safeguard the life, health and property of people, mainly from natural disasters, serious fires etc. Because non compliance can cause serious problem, penal provisions including imprisonment for offenders are also set in the BSL and regulations. New social expectations such as energy efficiency and accessibility are

considered not to fit for such framework, at least at the present time. Therefore, instead of expanding the scope of the BSL, separate acts have been enacted for these new policies.

Generally, these acts show aspirational codes and encourage people to use them at first. Once the new concept has been generally accepted by the public, the binding forth will be subsequently strengthened as to the degree of the social demand. As for accessibility, the act for the promotion of measures was enacted in 1994, and mandatory requirements on buildings larger than certain scale were introduced for the first time in 2002. As for energy efficiency, measures have been strengthened step by step since the enactment of the promotion act in 1979. At present, submission of an energy efficiency plan is mandatory for a building larger than certain scale. Though in the separate acts, technical requirements are coordinated with those of the BSL and regulations. The MLIT is in charge of the building part of these acts as well.

THE NETHERLANDS

To improve the quality of the living conditions of the working classes, the first Housing Act was accepted by the Dutch Parliament in 1901. Originally the Housing Act was dealing with public order, safety and health. The current Dutch building regulations are established from the point of view of safety, health, functionality, energy economy and the environment.



WET VAN DEN 22sten JUNI 1901 (Staatsblad No. 158),

houdende wettelijke bepalingen betreffende de volkshuisvesting.

WIJ WILHELMINA, BIJ DE GRATIE GODS, KONINGIN DER NEDERLANDEN, PRINSES VAN ORANJE-NASSAU, ENZ., ENZ., ENZ.

Allen, die deze zullen zien of hooren lezen, saluut! doen te weten:

Alzoo Wij in overweging genomen hebben, dat het wenschelijk is bepalingen vast te stellen betreffende de volkshuisvesting;

Zoo is het, dat Wij, den Raad van State gehoord, en met gemeen overleg der Staten-Generaal, hebben goedgevonden en verstaan, gelijk Wij goedvinden en verstaan bij deze:

§ 1. *Voorschriften betreffende aan woningen te stellen eischen.*

Artikel 1.

1. De gemeenteraad stelt voorschriften vast betreffende de eischen, waaraan moet worden voldaan:

a. bij het bouwen van woningen,

b. bij het geheel of voor een gedeelte vernieuwen van woningen,

c. met betrekking tot bestaande niet onder *b* begrepen woningen.

2. De gemeenteraad stelt voorschriften vast nopens behoorlijke bewoning.

Artikel 2.

1. De voorschriften, in artikel 1 bedoeld, kunnen verschillend zijn naar gelang van den aard en de bestemming der woningen, alsmede van hare ligging.

2. Bij die voorschriften kunnen eischen worden gesteld omtrent de zuivering van ongedierte, de afscheiding van slaapplaatsen, het

NEW ZEALAND

The purpose of the Act is to provide for the regulation of building work and to ensure, that people can:

- Use buildings safely without endangering their health; and
- Escape the building in the event of fire.

And that buildings:

- Have attributes that contribute appropriately to the health, physical independence and wellbeing of the people who use them; and
- Are designed, constructed and able to be used in ways that promote sustainable development.

The Act also includes principles to be considered when making decisions under the Building Act, which include:

- Harmful effects on human health resulting from the use of building methods, products, design or building work need to be prevented or minimised;
- Special traditional and cultural aspects of the intended use of a building need to be recognised;
- Buildings of significant cultural, historical or heritage value need to be preserved;
- The whole-of-life costs of a building need to be considered;
- Innovation in methods of building design and construction is important;
- Energy use in buildings needs to be efficient;
- The use of renewable sources of energy needs to be encouraged;
- Material use in buildings needs to be efficient and sustainable;
- Water use in buildings needs to be efficient and promote water conservation; and
- Waste generated during the construction process needs to be reduced.

NORWAY

The regulations are mainly concerned with public interests and less with individual needs or comfort issues. Safety aspects are basically related to human and animal safety, but there are requirements to reduce material losses. The requirements are to buildings and works themselves, but also concerned with the impact of the buildings and structures on the environment and public interest at large.

SCOTLAND

The main aim of the Scottish building standards system is to protect the public interest. On the surface public interest does not take into account the needs or wants of the individual, however that is not to say that the buildings of individuals are ignored by the building regulations. The regulations cover issues to ensure the health, safety and welfare of residents in dwellings are addressed for the betterment of society as a whole.

The system does not overtly consider personal property protection to be in the public interest and leaves this to the individual or, in the case of commercial or industrial buildings, frequently the insurer to resolve. However, certain life safety aspects do have a positive influence on property protection, for example, compartmentation or separation requirements.

It is also in the public interest to have some means of limiting the use of natural resources and reducing carbon dioxide emissions in a building standards system. Although Scotland

has had regulations covering the heated envelope of a building to reduce the transmission of heat for many decades, a requirement to reduce carbon dioxide emissions has recently been added. The Building (Scotland) Act 2003 also introduced a high level objective of "furthering the achievement of sustainable development".

The system, therefore, has gone beyond its original remit of producing domestic and non-domestic buildings of all types, whether privately owned or public, to an agreed minimum standard for the Scottish society. It could now be argued that "public interest" now extends beyond the confines of the Scottish borders and is considered in a global context.

SINGAPORE

Although the primary concern of Singapore's Building Control Act is in ensuring structural safety of the building, the provisions of the Act also extends to matters pertaining to amenities including ceiling heights, safety barriers to prevent falling from height, light and ventilation.

In terms of public interest, the purview of the Act and its various Regulations has also been extended to address issues in the following areas:

- Structural safety of other properties close to a building under construction;
- Safety of people who use or walk by the building – for example, with provisions that regulate the safety of windows and air-conditioners that may fall on to a public area;
- Cost-effectiveness and productivity, with provisions to improve the efficiency and standardization in designs, processes, construction techniques, products and materials;
- Improved accessibility to and in buildings for people with disabilities; and
- Energy efficiency and environmental sustainability measures.

SPAIN

The purpose of the Building Act 1999 is to regulate the building process by establishing guarantees needed to ensure the compliance with certain basic building requirements and to protect users' interests. Consequently the basic requirements are defined in order to guarantee people's safety, society's well-being and the protection of the environment. Thus the Act says that buildings must be projected, constructed, maintained and conserved in such a way as to satisfy the following basic requirements:

a) Functional Requirements which include Utility, Accessibility Access to telecommunications;
b) Safety Requirements which include Structural safety, Safety in case of fire and Safety of use; and
c) Habitability Requirements which include Safety, hygiene and environmental protection, Noise protection, Energy savings and thermal, and other functional aspects of the constructive elements or services which allow the building to be used satisfactorily.

In the same way, the Code develops these basic requirements into specific and detailed performance requirements.

SWEDEN

The building regulations express the society's minimum technical requirements on works. The Swedish building regulations states the national demands relating to the six essential requirements as mentioned in Annex 1 of the Constructions Products Directive (89/106/EEC) and three national ones: suitability for the intended purpose, accessibility and usability for disabled persons, efficient use of water and minimum waste disposal. Political demand for more energy efficient buildings has recently lowered the acceptable level of energy usage for heating, warm water, ventilation etc. This is especially the case if the building is considered to be heated by electricity which includes the usage of electricity for heating pumps. The regulations are thus mainly concerned with public interests and less with individual needs which is dealt with in other legislation.

USA

The scope of typical model building codes in the USA is focused primarily on the general health and welfare of the public as a whole, but has a strong focus on the protection of individuals. This is seen with requirements such as quick response sprinklers that may protect those fairly intimate with the area of fire origin. The heavy use of sprinklers is seen by many as protection of individual safety. More specifically all residential structures other than one and two family dwellings are required to be sprinklered in the 2006 International Building Code and International Fire Code. Smoke alarms within individual dwelling units are also required. This includes one and two family dwellings as well. The United States is also an extremely litigious society and this atmosphere has likely led to many of the code requirements in the current codes.

In terms of society as a whole, proper enforcement of building codes tends to reduce the amount of losses in events such as hurricanes and earthquakes. Such prevention of failure both saves lives but is essential to the economic vitality of a community and to the entire country in many cases. The code also does differentiate through its requirements between buildings seen as more essential then others. For instance when it comes to structural provisions in the IBC buildings are divided by occupancy category which essentially means the level of importance to society. For instance a hospital is category IV whereas agricultural buildings are category I. The ICCPC has used this same approach for all hazards in a community but leaves the categories up to the adopting jurisdiction.

As noted in the discussion on the scope of the regulations in Section 2.2.8 in a primarily prescriptive regulatory environment it is often difficult to understand to what degree society or individuals are protected and from what. Certain hazards are clearly addressed in scope, but to what degree is sometime open to interpretation. For example, fire clearly is a subject addressed by the ICC family of codes, and those involved in the code development process over a period of time understand that the code was not intended to deal with cases of arson

or acts of terrorism, but this may not be understood the same by the general public. Another area of confusion is the role of the egress requirements.

ANNEX C – EXISTING BUILDING SUMMARY DISCUSSION AND SURVEY RESPONSES

BUILDING REGULATIONS FOR EXISTING BUILDINGS[30]

In most countries, new construction accounts for a very small fraction of the total building inventory. For some building regulatory issues of key importance there is a need to have a more rapid impact on the performance and quality of the entire building stock, which results in the application of building regulations to existing buildings. We have seen earlier that it is very difficult to develop a common approach to building regulations for new buildings because of different legal practices in various countries. In regulating existing buildings this is further complicated by the huge differences between countries with respect to the age and condition of the existing building stock and also with respect to the cultural and social environment. For example there may be substantial differences between countries on the notion of the rights of a homeowner and regarding societal preferences for preservation as opposed to replacement of old buildings. The work done by IRCC to better understand these differences and how each country sets its own framework for regulating existing buildings is the result of a survey and discussions on the responses received from eight countries. The questionnaire addressed several aspects of building regulations for existing buildings and the responses revealed that on some aspects the differences between countries - and sometimes within the same country – are such that it is very difficult to report on common principles or practices that are shared by most countries. This paper therefore concentrates on those aspects of the survey where there appears to be a more common approach among IRCC members.

TRIGGER MECHANISMS

In most IRCC countries the building regulations for new buildings also apply to existing buildings when there is a major renovation or alteration, an addition or extension of the building and also when there is a change of use of the building (for example the conversion of a building from a commercial to a residential use). This would normally be associated to a requirement to obtain a building or occupancy permit from the local authority. At this point many factors may be considered to determine what portions of the existing building shall be upgraded to comply with current regulations for new buildings. Such factors may

[30] Extracted from Bergeron, D., "Codes for Existing Buildings: Different Approaches for Different Countries," proceedings of the *7th International Conference on Performance-Based Codes and Fire Safety Design Methods*, SFPE, Bethesda, MD, USA, May, 2008, pp.15-23.

include: the size of the building extension and how it is separated from the existing building; the size, condition and use of the existing building; the type of use affected by a conversion, etc. In some countries a renovation, extension or change of use of a portion of an existing building will require the entire building to be upgraded while in other countries only the portion of the building affected by this transformation will be covered by current regulations for new buildings and the rest of the building would not need to be upgraded. In at least one country the required upgrading as result of a building renovation or extension will be limited to certain aspects such as safety from fire and access and facilities for people with disabilities. A change of use may however be a key factor and a conversion to residential units would automatically require the upgrading of the entire building.

In some countries requirements for licensing of certain types of premises (residences for elderly people, liquor permits, large assembly halls, etc.) also constitute triggers for compliance to building regulations, which in most cases will require upgrading of key safety and health aspects of the building.

Some countries have developed separate codes or regulations for existing buildings and the survey results indicate that they may differ substantially from one country to another. In many countries fire safety regulations administered by the fire authorities are in place and apply to the ongoing maintenance and use of existing buildings. These regulations would typically focus on key fire safety aspects of buildings, which may include automatic alarms and fire suppression systems, means of egress, occupant load, fire separation and fire resistance of key building elements, etc. For specific fire hazards these regulations could require upgrading of fire protection measures. In at least one jurisdiction a requirement for mandatory fire risk assessment of all workplaces may lead to the upgrading of certain features of an existing building. In other countries however codes or regulations for existing buildings cover much broader aspects of buildings than fire and may include, for certain types of premises, requirement related to hygiene, indoor air quality, etc. In some countries such broad application of regulations for existing buildings would cause application and verification problems because, unlike fire regulations, the verification regime in place does not offer the framework and expertise necessary to verify compliance for non-fire safety related issues.

Mandatory upgrading regulations have been adopted in some countries to force the immediate upgrading of existing buildings with respect to certain regulatory goals or issues. These regulations may not be tied to any building work or transformation and are generally administered using an upgrading schedule determined by factors such as age and condition of the building, size and use, etc. Several countries have been using this mechanism to force the upgrading of buildings to provide access and facilities for people with disabilities. More recently this mechanism is being considered or used in a growing number of countries for achieving performance targets in the areas of energy and water conservation and other sustainability related goals. In earthquake prone countries this mechanism is also used to require the upgrading of the seismic resistance characteristics of certain types of buildings when it is determined that their current performance level is below an established minimum threshold. Some jurisdictions also use this mandatory upgrading mechanism to mandate the installation of automatic sprinklers in certain types of buildings.

Through mandatory periodic inspections of certain aspects of existing buildings some countries use a different mechanism to mandate the correction of dangerous and unhealthy conditions and the upgrade of related building components. This mechanism is typically used in critical safety areas through the mandatory inspection of electrical and gas installations, elevators and lifts, pressure vessels and boilers, etc. In one country this mechanism is applied to broader issues and includes the mandatory inspection of buildings for structural sufficiency, general condition and maintenance of the building envelope (for example the water tightness of facades, roof, basements), etc. Upgrading may be required as result of these mandatory inspections and some governments offer financial assistance to the building owner to facilitate application of the regulation.

In addition to regulatory instruments most countries will also use a broad variety of voluntary compliance measures. They essentially aim at encouraging building owners to maintain their buildings in good condition and to voluntarily upgrade certain key building features to help the government achieve their performance targets. Depending on the country this approach takes the form of promoting building upgrades through the development and dissemination of guidelines and education material on issues as diversified as energy conservation, seismic resistance, safety, etc.

LEVELS OF PERFORMANCE

Recognizing that it is often impossible to directly apply to an existing building requirements intended for new construction all countries will allow flexibility in the choice of solutions to achieve the building regulatory goals. Where the survey indicates differences between countries is with respect to the performance level of the solutions for existing buildings compared to the requirements for new buildings.

With exception of two countries all respondents reported that there is a clear provision in the building regulations that the performance expected from upgrading of existing buildings does not necessarily need to be equivalent to that for new construction. In other words the performance level required of existing building upgrades may be less than that for new construction work. These decisions as to what constitutes an acceptable level of performance are often made at local or regional government level. Some countries have developed sets of prescriptive requirements for existing buildings to express what constitutes an acceptable level of performance. In other jurisdictions where a functional or performance based approach is well established for new construction there may be allowance for use of risk assessment and similar decision-making tools to determine the acceptable level of performance of solutions for existing buildings.

At least two jurisdictions have indicated that only certain key aspects of existing buildings – generally those directly impacting occupant safety and health – would require to be upgraded to current standards for new construction and that for the other building components the building regulations in place at time of building construction would be used to govern upgrading work. In at least one country seismic resistance regulations for existing buildings have allowances for relaxations of the schedule of work, meaning that corrective work may be phased over a longer period of time than what would be expected for new construction.

Two countries where the functional or performance approach is well established have responded that the level of performance of existing building upgrades is equivalent to that of new construction work. Such building regulatory frameworks offer opportunity for alternative solutions to be proposed, provided it can be demonstrated that they provide an equivalent level of performance.

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